SPECIFICATIONS

41-A DISTRICT COURT
CHARTER TOWNSHIP OF SHELBY
BID ISSUE
SPEC NUMBER: 0132-1001
JULY 10, 2017

PROJECT

41-A DISTRICT COURT
SHELBY TOWNSHIP
BID ISSUE

OWNER
Charter Township of Shelby
52700 Van Dyke Avenue
Shelby Township, Michigan 48316

ARCHITECT
Anderson, Eckstein & Westrick
51301 Schoenherr
Shelby Township, MI 48315
SPECIFICATIONS

PROJECT NUMBER 0132-1001
JULY 10, 2017

PROJECT
SHELBY TOWNSHIP
NEW 41-A DISTRICT COURT
BID ISSUE

OWNER
CHARTER TOWNSHIP OF SHELBY
52700 VAN DYKE AVENUE
SHELBY TOWNSHIP, MI 48316

ARCHITECT/STRUCTURAL
ANDERSON, ECKSTEIN & WESTRICK
51301 SCHOENHERR ROAD
SHELBY TOWNSHIP, MI 48315
586-726-1234

MECHANICAL/ELECTRICAL/PLUMBING
PETER BASSO ASSOCIATES
5145 LIVERNOIS ROAD - SUITE 100
TROY, MI 48098
248-879-5666
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<td>Wiring Devices</td>
<td>10</td>
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<tr>
<td>16145</td>
<td>Lighting Control Devices</td>
<td>13</td>
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<td>16211</td>
<td>Electricity Metering</td>
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<td>16231</td>
<td>Packaged Engine Generators</td>
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<td>16289</td>
<td>Surge Protective Devices</td>
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<td>16410</td>
<td>Enclosed Switches and Circuit Breakers</td>
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<td>16415</td>
<td>Transfer Switches</td>
<td>9</td>
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<td>16420</td>
<td>Enclosed Controllers</td>
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<td>16441</td>
<td>Switchboards</td>
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<td>16442</td>
<td>Panelboards</td>
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<td>16491</td>
<td>Fuses</td>
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<td>16512</td>
<td>LED Interior Lighting</td>
<td>16</td>
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<tr>
<td>16512A</td>
<td>Lighting Fixture Cutsheets</td>
<td>57</td>
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<td>16521</td>
<td>Exterior Lighting</td>
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</tr>
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<td>16714</td>
<td>Communication Equipment Room Fittings</td>
<td>7</td>
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<tr>
<td>16721</td>
<td>Fire Alarm</td>
<td>20</td>
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<tr>
<td>16999</td>
<td>Electrical Testing</td>
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**DIVISION 17**

**Telecommunications**

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
<th>Quantity</th>
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<tbody>
<tr>
<td>17010</td>
<td>Telecommunications General Requirements</td>
<td>9</td>
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</tbody>
</table>
ADVERTISEMENT FOR BID
41-A DISTRICT COURT SHELBY TOWNSHIP

PROJECT
41-A District Court
Shelby Township
Senior Center Interior Renovations
AEW Project No. 0132-1001

OWNER
Shelby Township
52700 Van Dyke
Shelby Twp., Michigan 48316

LOCATION
Shelby Township
52420 Van Dyke
Shelby Twp., Michigan 48316

ARCHITECT/ENGINEER
Anderson, Eckstein & Westrick, Inc.
51301 Schoenherr Road
Shelby Township, Michigan 48315
(586) 726-1234

DESCRIPTION
The scope of work involved for this project is as follows: A new 20,660 square foot 41-A District Court Building.

SCOPE OF PROPOSAL
Sealed proposals are invited for the Project and will be received at the Office of the Owner until 2:00 pm, local time; Monday, July 31, 2017. Bids will be publicly opened and read aloud in the offices of the Township Clerk immediately thereafter.

PRE-BID MEETING
A pre-bid mandatory meeting will be held at the office of the owner, 52700 Van Dyke at 10:00 am Monday, July 17, 2017. Pre-bid questions shall be submitted to the Architect before July 21, 2017 1:00 pm, local time.

DOCUMENTS
Documents and requirements can be viewed at the office of the owner and at the office of the Architect/Engineer. Documents and requirements will be available Monday, July 10, 2017 after 1:00pm. Copies are available at a cost of $15.00 per set which is non-refundable.

This solicitation, along with all attachments may be downloaded from the Michigan Intergovernmental Trade Network (MITN) at www.mitn.info. Documents shall be available on or after July 10, 2017 at 1:00pm local time. Any and all Addenda issued by Shelby Township must be viewed or downloaded from the above listed website.

BID GUARANTEE AND CONTRACT SECURITY
Each bid proposal shall be accompanied by a certified check, bank draft or satisfactory bid bond in an amount of 5% of the maximum bid amount. Checks shall be made payable to Shelby Township. Bids may not be withdrawn for a period of sixty (60) calendar days after receipt of bids. The successful bidder will be required to furnish the required insurance and bond certificates.

RIGHTS OF THE OWNER
The Owner reserves the right to reject any or all proposals and to waive irregularities in bidding, or to accept the lowest responsible proposal that, in the opinion of the Owner, will serve his best interest.

DATED: June 2017

Shelby Township
SECTION 00100 - INSTRUCTIONS TO BIDDERS

Owner will receive sealed proposals only as set forth in the Invitation to Bid and complying with all requirements as contained in Instructions to Bidders.

DOCUMENTS

Bidding documents consist of plans and specifications as prepared by Anderson, Eckstein & Westrick, Shelby Township, Michigan.

Bid documents can be downloaded from the Michigan Intergovernmental Trade Network (MITN) at www.mitn.info beginning July 10, 2017 after 1:00pm.

Copies of the Bidding documents will also be on file for reference at the office of:

1. The Owner
2. The Architect

BIDDING DOCUMENTS

The Bidding Documents consist of the following:

The Drawings as enumerated in Section 00851, Index of Drawings.

The Specifications as enumerated in the Table of Contents.

All other documents as provided for in Article 1, Paragraph 1, Section 1 of the General Conditions as modified.

EXAMINATION

Each bidder shall examine the Bidding Documents and satisfy himself about the extent of the proposed work by personal examinations of the site and surroundings, and make his own estimate therefrom of the facilities and difficulties attending the performance and completion of the job.

No additional compensation will be allowed on account of conditions which could be determined by examining the Bidding Documents or the site.

INTERPRETATION

If any person contemplating submitting a bid is in doubt as to the true meaning of any part of the Drawings, Specifications, or other Bidding Documents, he must submit to the Architect a written request for an interpretation thereof. If such an interpretation
is not requested, the bids will be presumed to be based upon the interpretation and directions given by the Architect after Contract award, in accordance with provisions of the Contract.

Neither the Owner nor the Architect will be responsible for any verbal explanations or interpretations of the Bidding Documents.

Every request for such interpretation should be in writing, addressed to the Architect at his office, and to be given consideration, must be received at least ten (10) days prior to the date fixed for the opening of bids. Any and all such interpretations, and any supplemental instructions will be in the form of written addenda to the Bidding Documents which, if issued, will be mailed to all prospective bidders (at the respective address furnished for such purposes) prior to the date fixed for the opening of bids. All addenda so issued shall become part of the Bidding Documents.

SUBSTITUTIONS

To obtain approval to use unspecified products, bidders shall submit written requests at least five (5) days before the bid date. Requests received after this time will not be considered. Requests shall clearly describe the product for which approval is asked, including all data necessary to demonstrate acceptability. If the product is acceptable, the Architect will approve it in an Addendum issued to all prime bidders on record.

BASIS OF BID

A single lump sum proposal is being entertained for the complete work of this proposal.

Partial or segregated bids or assignments will not be considered. Include quotes for all alternates and unit prices; failure to do so may result in rejection of the proposal.

PREPARATION

Proposal shall be submitted on the form bound in these specifications, Form of Proposal, in original form without erasures, interlineations or alterations.

Submit three (3) copies of proposal, retain one for your records. Oral, fax, email, or telephone proposals will not be accepted.

Proposals must be filled out in ink or typewritten in duplicate. Blank spaces in the proposals must be filled in and no changes shall be made to the phraseology of the proposal. Quotes shall be entered in verbal and numeric forms. In case of a discrepancy
between the written and the numeric form, the written form shall govern.

All bids shall be signed and dated in longhand.

Bids which are not signed by the individual making them should have attached thereto a power of attorney, evidencing authority to act as agent for the person whom it is signed.

Bids which are signed for a partnership should be signed by one of the partners or by an attorney-in-fact. If signed by an attorney-in-fact, evidence of authority to sign the bids shall be attached.

Bids which are signed for a corporation should have the correct corporate name thereon and the signature of the president or other officer legally able to contract in the name of the corporations. In addition, a signed Secretary's Certificate evidencing the authority of the Officer to contract in the name of the corporation shall be included. Any proposal submitted by a corporation shall bear its seal.

BID SECURITY

The successful bidders securities will be retained until they have signed the Contract and furnished the required payment and performance bonds. The Owner reserves the right to retain the security of the next two lowest bidders for each contract until the lowest bidders enter into contract, or until sixty (60) days after the bid opening, whichever is the shorter. All other bid security will be returned as soon as practicable. If any bidder refuses to enter into a Contract, the Owner will retain his Bid Security as liquidated damages, but not as a penalty.

SUBCONTRACTORS

The Owner and Architect reserve the right to require of bidders tentatively selected for consideration in the awarding of the Contract, a list of the subcontractors whom the Contractor intends to employ.

The Owner reserves the right to disapprove the use of any proposed subcontractor, and in such event, the bidder submitting such subcontractor shall submit another such subcontractor in like manner within the time specified by the Owner. The Owner reserves the right to reject any bid if such information required by the Owner is not submitted as above indicated.
Submit proposals in sealed opaque envelopes having listed thereon the following:

**PROPOSAL: 41-A DISTRICT COURT**
**SHELBY TOWNSHIP**
**ATTN: STANLEY GROT, CLERK**

**Contractor:**

**WITHDRAWAL**

Proposals for base bids may not be withdrawn for a period of sixty (60) days after the time established for the receiving of proposals. Bidders may withdraw at any time prior to the time set for the receiving of proposals.

**IRREGULARITIES**

The Owner reserves the right to disqualify Bids before or after opening, upon evidence of collusion with intent to defraud, or other illegal practices upon the part of the bidder.

The Owner also reserves the right to reject any or all bids in whole or in part and to waive any informalities therein.

Any error and/or omission in the proposal form or any other irregularity as a result of negligent preparation shall not furnish cause for relief for any damages resulting therefrom, nor in any way relieve the Contractor from fulfillment of all contractual obligations as provided for in the Bidding Documents.

**TAXES AND CONTRIBUTIONS**

Proposal, unit prices, alternate prices stated include all taxes or contributions required by bidders business.

Michigan State sales tax is applicable to this work.

**OPENING**

Proposals will be publicly opened and read aloud.
BID BREAKDOWN CONSTRUCTION INFORMATION

Upon notice from the Architect, the low bidders shall submit a detailed cost breakdown of all work covered by the Bidding Documents. The breakdown shall show quantity of material and labor, units of material and labor, material cost, labor cost and total cost.

AWARD OF CONTRACT

The Contract will be awarded to the lowest responsible bids, complying with the terms of the Bidding Documents, with full consideration of alternates.

EXECUTION OF CONTRACT

The Owner reserves the right to accept any and all bids, or to negotiate contract terms with the various bidders when such is deemed by the Owner to be in his best interest.

END OF SECTION 00100
SECTION 00311 – PROPOSAL FORM/ALL TRADES

Name of Contractor

Address, City, Zip

Phone #/Fax #

Email Address

PROJECT
41-A DISTRICT COURT

OWNER
CHARTER TOWNSHIP OF SHELBY
52700 VAN DYKE AVE
SHELBY TOWNSHIP, MICHIGAN 48316

ARCHITECT
ANDERSON ECKSTEIN & WESTRICK
51301 SCHROENHER ROAD
SHELBY TOWNSHIP, MICHIGAN 48315

BASE PROPOSAL
Pursuant to and in compliance with the Invitation to Bid and the Instructions to Bidders, and having carefully examined the Bidding Documents with the Owner to complete the work in accordance with the said Bidding Documents (including an Owner directed contingency of [$130,000.00]) for the sum of:

(Sum to be written out)

____________________________________________________Dollar $__________________________________________
BREAKDOWN OF BASE PROPOSAL:

SITE WORK (See Supplemental Site Itemized Breakdown Form)

FOUNDATIONS & FLAT WORK ($_____________) DOLLARS
STRUCTURAL STEEL ($_____________) DOLLARS
MECHANICAL & PLUMBING ($_____________) DOLLARS
ELECTRICAL ($_____________) DOLLARS
GENERAL BUILDING TRADES ($_____________) DOLLARS
CONTINGENCY ($130,000) DOLLARS

TOTAL LUMP SUM BASE PROPOSAL BID ($_____________) DOLLARS

ALTERNATES

The undersigned further proposes to execute the work specified in the respective technical division or indicated on the drawings for the sum added to the base proposal as stated below:

Alternate No. 1: Construction Management (At Risk Services) in lieu of General Contractor services.

Dollars for General Conditions $______________

Construction Management Fee ___ Percent of Total Project Costs

VOLUNTARY ALTERNATES

The following voluntary alternates are offered by the bidder. The undersigned agrees the amounts indicated below shall be added to or deducted from the Base Bid, as the case may be, for each alternate which is accepted.

<table>
<thead>
<tr>
<th>Description of Voluntary Alternates</th>
<th>Add</th>
<th>Deduct</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
PRICE GUARANTEE

The undersigned proposes that the price stated in this Proposal is guaranteed for sixty (60) consecutive days from bid date.

TAXES

The undersigned acknowledges that the price stated above includes all taxes of whatever character or description.

SUPPLEMENTAL FEES

For additional work performed upon instruction of the Owner by subcontractors of the undersigned, add to the subcontractor’s prices for such additional work a fee of _____% which includes all the charges of the undersigned for overhead and profit.

Any additional work performed upon instructions of the Owner by persons other than the subcontractors of the undersigned, the charges will be actual cost of all labor and materials (less all discounts) plus the fee of _____% which includes all the charges of the undersigned for overhead and profit and to which shall be added the actual cost of insurance and taxes.

Each proposal covering extra work shall be accompanied with complete itemized materials and labor break downs.

For all revisions involving the deletion of contract work, it is agreed that full credit shall be given the Owner for such work deleted, including overhead and profit as quoted hereinbefore.

TIME OF COMPLETION

The undersigned agrees to commence work operations immediately upon award of contract with substantial completion of the work by May 31, 2018 and that the proposed bid is in full consideration of this.

ADDENDA

If any addenda or bulletins covering changes to the Bidding
Documents have been received during the bidding period, the bidder shall fill in their numbers and dates which acknowledges having received same, and having included in this Proposal the work involved:

_________________________________________ Dated ________________

_________________________________________ Dated ________________

_________________________________________ Dated ________________

BID SECURITY

A bid bond executed by a U.S. Treasury Listed Surety Company acceptable to Charter Township of Shelby or a cashier’s check in the amount of 5% of the sum of the proposal payable to Charter Township shall be submitted with each proposal. All proposals shall be firm for a period of sixty (60) days.

PERFORMANCE AND LABOR BOND

Successful bidders will be required to furnish a U.S. Treasury Listed Company Performance and Payment Bond in the amount of 100% of their bid. The cost of the Bond shall be included in each proposal.

The Charter Township of Shelby reserves the right to reject any and/or all bids in whole or in part and to waive any informality therein. The Charter Township of Shelby reserves the right to accept the bid which in its opinion, is in the best interest of the Owner.

FAMILIAL DISCLOSURE

Bidder has included Section 00401 Familial Disclosure Form (bid will not be read without this form)

NEGOTIATION

The undersigned agrees that, should the overall cost exceed the funds available, he will be willing to negotiate with the Owner and Architect for the purpose of making further reductions in the Contract work, and shall agree to give full credit for all such reductions in the work requested by the Owner, including full value of labor, materials, and subcontract work and reasonable
proportionate reductions in overhead and profit, thereby arriving at an agreed upon Contract price.

CONTRACT EXECUTION

The undersigned agrees to execute a Contract for work covered by this Proposal, provided that he be notified of its acceptance within sixty (60) days after the opening of bids.

The undersigned hereby declares that he has the legal status checked below

(    ) Individual

(    ) Partnership having the following partners:

___________________________________________

___________________________________________

___________________________________________

(    ) Corporation incorporated under the State laws of:

___________________________________________

This proposal is submitted in the name of , and notice of acceptance should be mailed, faxed, or delivered to:

Date: ____________________________ Firm’s Name: ____________________________

___________________________________________

Phone No. (   )

By: ____________________________________________ (Signature)

In the presence of : ____________________________ Title: ____________________________

END OF SECTION 00311
Site Base Bid

ITEMIZED BID BREAKDOWN

<table>
<thead>
<tr>
<th>ITEM OF WORK</th>
<th>QUANTITY</th>
<th>UNIT</th>
<th>UNIT PRICE</th>
<th>AMOUNT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Bonds, Insurance and Initial Set-up Expense, Max 3%</td>
<td>1</td>
<td>LS</td>
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<tr>
<td>2. Remove Trees (6”-18”)</td>
<td>12</td>
<td>Ea.</td>
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<td>3. Remove Trees (19”+)</td>
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<td>Sawcut and Remove Asphalt Pavement</td>
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<td>4. Curb Removal</td>
<td>144</td>
<td>LF</td>
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<td>5. 6” PVC SDR 23.5 Sanitary Lead</td>
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<td>LF</td>
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<td>6. Tap Existing Sanitary Manhole</td>
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<td>Ea.</td>
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<tr>
<td>7. 8” Class 54 Ductile Iron Water Main</td>
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<td>8. 6” Class 54 Ductile Iron Water Main</td>
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<td>9. 2” HDPE Water Service</td>
<td>88</td>
<td>LF</td>
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<tr>
<td>10. Standard Hydrant Assembly</td>
<td>2</td>
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<tr>
<td>11. 8” Gate Valve in Well</td>
<td>2</td>
<td>Ea.</td>
<td></td>
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<tr>
<td>12. Relocate Existing Hydrant</td>
<td>1</td>
<td>Ea.</td>
<td></td>
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<tr>
<td>13. Connect to Existing Water Main</td>
<td>2</td>
<td>Ea.</td>
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<td>14. 18” C-76 CL. IV Storm Sewer</td>
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<tr>
<td>15. 8” Perforated PVC w/ sock</td>
<td>673</td>
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<td>16. 6” Solid Wall PVC</td>
<td>413</td>
<td>LF</td>
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<td>17. 6” Perforated PVC w/ sock</td>
<td>476</td>
<td>LF</td>
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<td>18. Infiltration Trenching</td>
<td>1,335</td>
<td>LF</td>
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<td>19. Tap Existing Storm Manhole</td>
<td>2</td>
<td>Ea.</td>
<td></td>
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<td>20. 2’ Diameter Inlet</td>
<td>13</td>
<td>Ea.</td>
<td></td>
<td></td>
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<td>21. 4’ Diameter Catch Basin</td>
<td>1</td>
<td>Ea.</td>
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<td>22. 6” Asphalt Pavement, 10” Base</td>
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<td>23. 4” Asphalt Pavement, 6” Base</td>
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<td>Item of Work</td>
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<td>Unit</td>
<td>Price</td>
<td>Amount</td>
</tr>
<tr>
<td>------------------------------------</td>
<td>----------</td>
<td>------</td>
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<tr>
<td>8&quot; Concrete Pavement</td>
<td>25</td>
<td>SY</td>
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<tr>
<td>Curb Face Concrete Walk - 8' Wide</td>
<td>2,381</td>
<td>SF</td>
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<tr>
<td>4&quot; Concrete Sidewalk</td>
<td>3,900</td>
<td>SF</td>
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<td>Detectable Warning Surface</td>
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<td>Ea.</td>
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<tr>
<td>6&quot; Concrete Curb</td>
<td>838</td>
<td>LF</td>
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<tr>
<td>Decorative Bollard</td>
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<tr>
<td>Striping</td>
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<td>Landscaping</td>
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<td>Irrigation System</td>
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<td>Topsoil, Seed and Mulch</td>
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<td>LS</td>
<td></td>
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<tr>
<td>Mass Grading / Earthwork</td>
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<td>LS</td>
<td></td>
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<tr>
<td>Dewatering</td>
<td>1</td>
<td>LS</td>
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<tr>
<td>Soil Erosion and Sedimentation</td>
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<td>LS</td>
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<tr>
<td>Sedimentation Control</td>
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<td>LS</td>
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<tr>
<td><strong>Total Site Bid Amount</strong></td>
<td></td>
<td></td>
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</tbody>
</table>
SECTION 00401 - FAMILIAL DISCLOSURE STATEMENT

All Bidders must complete the following familial disclosure form in compliance with MCL 380.1267 (Public Act 232 of 2004) and attach this information to the bid.

By the attached sworn and notarized statement we are disclosing the following familial relationship(s) that exists between the owner or any employee of the bidder and any member of the Board of trustees, or employees of The Charter Township of Shelby and will not accept a Bid that does not include this sworn and notarized disclosure statement.

Disclose any familial relationship and complete the form below in its entirety:

The following are familial relationships as described above (provide employee name, family contact name, family contact position, and familial relationship or NONE.)

PRINT:
Company Name ____________________________________________
Phone________________
Street Address____________________________________________
City / State / Zip_________________________________________
Company Officer__________________________________________
Title________________
Officer’s Signature________________________________________
_____ Date_______________

STATE OF MICHIGAN )
) SS
COUNTY OF
On this ______ day of ____________, 20__, before me a Notary Public in and for said county, personally appeared ________________, agent of the said firm ______________________ and who acknowledged the same to be his free act and deed as such agent.

Notary Public ___________________________ Expiration Date _____________
Seal Imprint:

FAMILIAL DISCLOSURE STATEMENT 00401 - 1
AFFIDAVIT OF COMPLIANCE – IRAN ECONOMIC SANCTIONS ACT
Michigan Public Act No. 517 of 2012

The undersigned, the owner or authorized officer of the below-named Contractor, pursuant to the compliance certification requirement provided in the Chippewa Valley Schools (the “Owner”) Request For Proposals For Construction Services (the “RFP”), hereby certifies, represents and warrants that the Contractor (including its officers, directors and employees) is not an “Iran linked business” within the meaning of the Iran Economic Sanction Act, Michigan Public Act No. 517 of 2012 (the “Act”), and that in the event the Contractor is awarded a contract as a result of the aforementioned RFP, the Contractor will not become an “Iran linked business” at any time during the course of performing any services under the contract.

The Contractor further acknowledges that any person who is found to have submitted a false certification is responsible for a civil penalty of not more than $250,000.00 or 2 times the amount of the contract or proposed contract for which the false certification was made, whichever is greater, the cost of the Owner’s investigation, and reasonable attorney fees, in addition to the fine. Moreover, any person who submitted a false certification shall be ineligible to bid on a request for proposal for three (3) years from the date that it is determined that the person has submitted the false certification.

____________________________________
Name of Contractor

By: ________________________________

Its: ________________________________

Date: ______________________________

State of________________) )SS.
County of ______________)

This instrument was acknowledged before me on the _____ day of _______, 2016, by_______________________________.

____________________________________
Notary Public

_____________County,_________________

My commission expires on ____________

Acting in the County of ________________
SECTION 00403 NON-DISCRIMINATION IN EMPLOYMENT

TO __________________________________________________________

Name of union or organization of workers

The undersigned currently holds contract(s) with ______________________ (Applicant’s Name) involving funds or credit of the U.S. Government of (a) subcontract(s) with a prime contractor holding such contract(s).

You are advised that under the provisions of the above contract(s) or subcontract(s) and in accordance with Executive Order 11246, dated September 24, 1965, the undersigned is obliged not to discriminate against any employee or applicant for employment because of race, color, creed, or national origin. This obligation not to discriminate in employment includes, but is not limited to the following:

HIRING, PLACEMENT, UPGRAADING, TRANSFER, DEMOTION, RECRUITMENT, ADVERTISING, SOLICITATION FOR EMPLOYMENT, TRAINING DURING EMPLOYMENT, RATES OF PAY OR OTHER FORMS OF COMPENSATION, SELECTION FOR TRAINING INCLUDING, APPRENTICESHIP, LAYOFF OR TERMINATION.

This notice is furnished you pursuant to the provisions of the above contract(s) or subcontract(s) and Executive Order 11245. Copies of this notice will be posted by the undersigned in conspicuous places available to employees or applicants for employment.

PRINT:
Company Name _________________________________ Phone ______________________

Street Address _____________________________________________

City / State / Zip ____________________________________________

Company Officer ____________________________Title_____________________

Officer’s Signature _____________________________Date_____________________

NON-DISCRIMINATION IN EMPLOYMENT 000403 - 1
SECTION 00405 CONTRACTOR NOTIFICATION FORM FOR NEW OR RENOVATION WORK (In accordance with 40 CFR Part 763.84 [d] )

As required by the EPA AHERA standard, the Owner is responsible for providing Contractors with information regarding locations of known or assumed asbestos containing material prior to entering a building under the district's jurisdiction.

Please complete this form and return it to Anderson, Eckstein & Westrick.

I (We) representing and having authority for ___________________________________________ (company),

hereby indicate and agree that a representative of the Owner, ___________________________________________ (name and title), has provided me information regarding the specific locations and materials that are asbestos-containing materials which may be encountered or have the potential of being encountered during the course of activities involving ___________________________________________ (project name and job number) in ___________________________________________ (building).

I expressly agree that neither I nor any of my employees, agents, subcontractors or other individuals or entity over whom I have any responsibility or control, will disturb asbestos-containing materials as listed in the Management Plan for the above mentioned building.

I further understand and agree that should I, my employees, agents, subcontractors or other individuals or entities over whom I have control, encounter any material suspected of containing asbestos, said materials shall not be disturbed without first notifying the Owner and receiving approval that such material may be disturbed.

PRINT:

Company Name ____________________________________ Phone ____________________________

Street Address __________________________________________

City / State / Zip _________________________________________

Company Officer ___________________________ Title ____________________________

Officer’s Signature ____________________________ Date ____________________________

CONTRACTOR NOTIFICATION FORM 00405 - 1
SECTION 00406  CONTRACTOR’S CERTIFICATION OF ASBESTOS-FREE PRODUCT AND INSTALLATION

It is hereby understood and agreed that no products/materials containing asbestos, including Chrysotile, Amosite, Crocidolite, Tremolite Asbestos, Anthophyllite Asbestos, Actinolite Asbestos or any combination of these materials that have been chemically treated and/or altered shall be installed or introduced into the building by the Contractor or his employees, agents, subcontractors or other individuals or entities over whom the Contractor has control. The Contractor shall be required to sign this certification statement ensuring that all products or materials installed or introduced into a building will be asbestos-free.

The Contractor shall also be required to furnish certified statements from the manufacturers of supplied materials used during construction verifying their products to be asbestos-free in accordance with the previous paragraph.

Project’s Name: __________________________________________
Project’s Address: ________________________________________
Project’s City/State/Zip: ___________________________________
Architect’s Name: ______________________________________  Project Number_____________

CONTRACTOR’S CERTIFICATION

We (I) certify and will direct that all products and materials that will be and/or have been installed or introduced into the above named Project shall be asbestos-free (or less than one-percent (1%) asbestos by weight).

PRINT:
Company Name ___________________________________________ Phone____________________
Street Address ____________________________________________
City / State / Zip __________________________________________
Company Officer _________________________________________ Title _____________________
Officer’s Signature ______________________________________ Date_____________________

CONTRACTORS CERTIFICATION OF ASBESTOS FREE PRODUCT  00406 - 1
NON-COLLUSION AFFIDAVIT

County )
 ) SS:

__________________________________________________ being first duly sworn,
deposes and says that he is the

________________________________________
(Individual, Partner, Corporate Officer)

making the foregoing proposals or bids; that such bids are genuine and not collusive or
sham; such bidder has not colluded, conspired, connived, or agreed, directly or indirectly,
with any bidder or person, to put in sham a bid, or that such other person shall refrain from
bidding and has not in any manner, directly with any person, to fix the bid price of afferent
or any other bidder, or to fix any overhead, profit or cost element of said bid price, or of that
of any other bidder, or to secure any advantage against the Joint Purchasers or any person
or persons proposal are true; and further, that such bidder has not, directly or indirectly
submitted this bid, or the contents thereof, or divulged information or data relative thereto
any association or to any member or to any member or agent thereof.

___________________________________
Sworn to and subscribed before me this _________ day of ___________, 20_______.
__________________________________
Notary Public

My commission expires on

BIDDER: THIS AFFIDAVIT MUST BE COMPLETED, SIGNED, NOTARIZED AND
INCLUDED IN YOUR BID SUBMISSION.
DOCUMENTS:

“The General Conditions of the Contract for the Construction” A.I.A Documents A-201, 2007 Edition, Forms a part of these Specifications and shall have the same effect as if bound herein.

This Document is modified as described in Modification of the General Conditions.

Contractors shall be held responsible for having familiarized themselves with this Document and all other documents affecting their contracts in this Specification.

END OF SECTION 00710
SECTION 00810 - MODIFICATIONS OF THE GENERAL CONDITIONS

The following modify, change, delete from, or add to the "General Conditions of the Contract for Construction" AIA Document A201, 2007 Edition. Where any Article of the General Conditions is modified or any Paragraph, Subparagraph or Clause thereof is modified or deleted by these Supplementary Conditions, the unaltered provisions of that Article, Paragraph, Subparagraph, or Clause shall remain in effect.

ARTICLE 1, GENERAL PROVISIONS

Add the following Subparagraph to Paragraph 1:

1.2.4 Work not covered in the Contract Documents will not be required, unless it is consistent therewith and is reasonably inferable therefrom as being necessary to produce the intended results. Where reference is made to specifications of manufacturers, trade associations or the like, such is understood to be made a part of this Specification to have the same effect as if fully reproduced herein. Approval or equal, acceptable, and words of similar definition are understood to mean in the judgment of Architect.

Add the following Subparagraph to Paragraph 1:

1.2.5 Computed dimensions take precedence over scaled dimensions, large scale details over smaller; should disagreements occur in the drawings, or the Specifications describe a higher quality of work or material, the better quality shall be estimated, unless otherwise directed by the Architect. The Architect shall be notified at once, in writing, of any and all discrepancies.

ARTICLE 3, CONTRACTOR

Add the following Subparagraph to paragraph 3:

3.4.4 After the Contract has been executed, the Owner and the Architect will consider a formal written request for the substitution of products in place of those specified only under the conditions set forth herein.
3.4.5 By making requests for substitutions based on Clause 3.1.3. above, the Contractor:

(a) represents that he has personally investigated the proposed substitute product and determined that it is equal or superior in all respects to that specified;

(b) represents that he will provide the same warranty for the substitution that he would for that specified;

(c) certifies that the cost data presented is complete and includes all related costs under this Contract, but excludes cost under separate contract, and excludes the Architect's redesign costs, and waives all claims for additional costs related to the substitution which subsequently becomes apparent; and

(d) will coordinate the installation of the accepted substitute, making such changes as may be required for the work to be complete in all respects.

Change Paragraph 3.7, Subparagraph 1, to read as follows:

3.7.1 General Trades Contractor shall secure and Owner pay for general building permit. General, Mechanical and Electrical Trades Contractors shall secure and pay for all other permits and governmental fees, licenses and inspections as their work may require for the proper execution and completion of the Work which are customarily secured after execution of the Contract and which are legally required at the time the bids are received.

3.7.1.1. Owner will pay for all sewer and water escrow fees, capital charges, assessment fees, and frontage fees.

3.7.1.2. All other fees, permits and tapping charges shall be applied for and obtained by Mechanical Trades Contractor, and shall be paid for by the Owner.

ARTICLE 5, SUBCONTRACTOR
Add the following Subparagraph to Paragraph 5:

5.2.1.1. No later than 10 days after the award of contract the Contractor shall furnish, in writing to the Owner through the Architect the names of persons or entities proposed or manufacturers for each of the products identified in the General Requirements (Division of the Specifications) and where applicable, the name of the installing subcontractor.
Article 7, CHANGES IN THE WORK
Add the following sentence to paragraph 7.3.7

7.3.7.6 The Contractor shall not incur any cost to be reimbursed as part of the adjustment in the contract sum prior to the commencement of the construction phase.

ARTICLE 8, TIME
8.3.1 Delete reference to arbitration.

ARTICLE 9, PAYMENTS AND COMPLETION
Add the following sentence to Subparagraph 9.3.1.: 

The form of Application for Payment shall be a notarized AIA Document G702, Application and Certification for payment, supported by AIA Document G703, Continuation Sheet.

Add the following Clause 9.3.1.3. to 9.3.1:

Until the work is 50% complete, the Owner shall pay 90% of the amount due the Contractor on account of progress payments. At the time the work is 50% complete and thereafter, the Architect may, upon written request and satisfactory progress authorize remaining partial payments to be paid in full.

ARTICLE 11, INSURANCE AND BONDS
Add the following Subparagraph:
11.1.1.9. Liability Insurance shall include all major divisions of coverage on a comprehensive basis including:

(1) Premised-Operations (including X-C-U)

(2) Independent Contractors Protective

(3) Products and Completed Operations

(4) Personal Injury Liability with Employment Exclusion deleted.

(5) Contractual—including specified provisions for Contractor's Obligation under Paragraph 3-18

(6) Owned, non-owned, and hired motor vehicles.

(7) Broad Form Property Damage, including Complete Operations.
Add the following Subparagraph:

11.1.1.1. If the General Liability coverages are provided by a Commercial General Liability Policy on a claims-made basis, the policy date or Retroactive Date shall predate the Contract; the termination date of the policy or applicable extended reporting period shall be no earlier than the termination date of coverages required to be maintained after final payment, certified in accordance with subparagraph 9.10.2.

Add the following Subparagraph:

11.1.2.1. The Insurance required by Subparagraph 11.1.1. shall be written for not less than any limits of liability specified in the Contract Documents, or required by law, whichever is greater. Provide minimum limits as follows:

(1) Worker's Compensation:

(a) State - statutory

(b) Applicable Federal - statutory

(c) Employer's Liability - $100,000

(d) Benefits required by Labor Union Contracts.

(2) Comprehensive General Liability, including Premises-Operations, Independent Contractor's Protective, Products and Completed Operations, and Broad Form Property Damage:

(a) Bodily Injury:

$1,000,000 Each Occurrence
$1,000,000 Aggregate Products and Completed Operations

(b) Property Damage:

$1,000,000 Each Occurrence
$1,000,000 Aggregate

(c) Product and Completed Operations Insurance shall be maintained for a minimum period of one year after final payment, and Contractor shall continue to provide evidence of such coverage to Owner on an annual basis during the coverage period. Name Charter Township of Shelby as additionally insured primary coverage.
(d) Property Damage Liability Insurance shall include coverage for X (Explosion), C (Collapse) and U (Underground).

(e) Contractual Liability (Hold Harmless Coverage):

Bodily Injury - $1,000,000 Each Occurrence
Property Damage - $1,000,000 Each Occurrence
$1,000,000 Aggregate

(f) Personal Injury with Employment Exclusion deleted:

$1,000,000 Aggregate

(3) Comprehensive Automotive Liability (Owner, non-owned, hired):

(a) Bodily Injury:

$500,000 Each Person
$1,000,000 Each Accident

(b) Property Damage:

$1,000,000 Each Occurrence

Add the following sentence to Subparagraph 11.1.3.: If this Insurance is written on the Comprehensive General Liability Policy form, the Certificates shall be AIA Document G705, Certificates of Insurance. If this Insurance is written on a Commercial General Liability Policy form, ACORD form 255 will be acceptable.

Add the following sentence to Clause 11.3.1.1.: The form of policy for this coverage shall be Complete Value.

Delete Clause 11.3.1.4 and substitute the following:

11.3.1.4 The Contractor shall provide insurance coverage for portions of the Work stored off the site after written approval of the Owner at the value established in the approval, and also for portions of the Work in transit.
11.3.9 Revise third sentence to read:

The Owner shall deposit in a separate account proceeds so received, which the Owner shall distribute in accordance with such agreement as the parties in interest may reach, or in accordance with a mediation or litigation award in which case the procedure shall be as directed by the mediator or the Court.

11.3.10 Revise second sentence to read:

The Owner as fiduciary shall in the case of mediation or litigation make settlement with insurers in accordance with the directions of the mediator or the Court. If distribution of insurance proceeds by mediation or litigation is required the mediator or the Court will direct such distribution.

11.4, PERFORMANCE BOND AND PAYMENT BOND

Delete Subparagraph 11.4.1 and substitute the following paragraphs:

11.4.1 The Contractor shall furnish bonds covering faithful performance of the Contract and payment of obligations arising hereunder. Bonds may be obtained through the Contractor's usual source and the cost thereof shall be included in the Contract Sum. The amount of each bond shall be equal to 100% percent of the Contract Sum.

11.4.1.1 The Contractor shall deliver the required bonds to the Owner not later than five days following the date the Agreement is entered into, or if the Work is to be commenced prior thereto in response to a letter of intent, the Contractor shall, prior to the commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished.

11.4.1.2 The Contractor shall require the attorney-in-fact who executes the required bonds on behalf of the surety to affix thereto a certified and current copy of the power of attorney.

Add the following Paragraph 13.8 to Article 13:

13.8 EQUAL OPPORTUNITY

13.8.1 The Contractor shall maintain policies of employment as follows:

13.8.1.1 The Contractor and the Contractor's Subcontractors shall not discriminate against any employee or applicant for employment because of race, religion, color, sex, or national origin. The Contractor shall take affirmative action to insure
that applicants are employed, and that employees are treated during employment without regard to their race, religion, color, sex or national origin. Such action shall include, but not be limited to, the following: employment, upgrading, demotion or transfer; recruitment or recruitment advertising; layoff or termination; rates of pay or other forms of compensation; and selection for training, including apprenticeship. The Contractor agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of non-discrimination.

13.8.1.2 The Contractor and the Contractor's Subcontractors shall, in all solicitations or advertisements for employees placed by them or on their behalf; state that all qualified applicants will receive consideration for employment without regard to race, religion, color, sex or national origin.

ARTICLE 15, CLAIMS AND DISPUTES

15.3 Mediation

15.3.2 Delete reference to Arbitration and substitute litigation.

15.3.2 Revise paragraph to read:

The parties shall endeavor to resolve their Claims by mediation which, unless the parties mutually agree otherwise, shall be in accordance with the Construction Industry Mediation Rules of the American Arbitration Association in effect on the date of this agreement. A request for mediation shall be made in writing, delivered to the other party to the Contract, and filed with the American Arbitration Association. The request may be made concurrently with the filing for litigation but, in such event, mediation shall proceed in advance of litigation or legal or equitable proceedings, which shall be stayed pending mediation for a period of 60 days from the date of filing, unless stayed for a longer period by agreement of the parties or Court order.

15.4 Delete reference to arbitration. Binding dispute resolution shall be by litigation in a court of law having jurisdiction.

15.4.4 CONSOLIDATION OR JOINDER

15.4.4.1, 15.4.4.2, 15.4.4.3
Delete reference to arbitration and substitute mediation
The following drawings, dated July 10, 2017, are issued for 41-A District Court, Shelby Township, Permit Issue, AEW Project #0132-1001.

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END OF SECTION 00851
SECTION 01010 - SUMMARY OF WORK

PART I - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division O, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this section.

1.02 PROJECT:

A. The project consists of all necessary material and labor to construction a new 20,660 sf 2-story District Court Building complete with holding cells, office space, dumbwaiter, Court Rooms and associated areas. Site work includes new asphalt paving, concrete walks, landscaping, irrigation, fencing, gates, lighting and underground utilities.

1.03 SCHEDULE:

A. After award of contract the schedule will be finalized with the successful bidder and Shelby Township Facilities & Operations.

B. The adjacent Shelby Township Police Station and other adjacent facilities will remain in operation during the construction period. Schedule and work operations must be coordinated with Shelby Township Facilities and Operations and Shelby Township Police Dept.

PARTS 2 & 3 - PRODUCT AND EXECUTION

Not applicable

END OF SECTION 01010
SECTION 01041 - PROJECT COORDINATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to other Sections of Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION:

A. Contractor shall provide the services of a full time Project Coordinator for the duration of the construction work.

1. Employ someone with not less than five years experience performing coordination work on projects of similar size and scope.

2. Submit name and qualifications to Architect.

B. Provide additional administrative and supervisory personnel as required for the performance of the work including coordination of the various subcontractors.

C. Related Requirements Specified in Other Sections:

1. Summary of Work: Section 01010.

1.03 PROJECT COORDINATOR'S DUTIES:

A. Coordinate the work of the various subcontractors:

1. For temporary utilities.

2. With the work of trades specified in Division 2 through 16.

B. Coordinate the schedules of subcontractors.

1. Verify timely deliveries of products for installation by other trades.

2. Verify that labor and materials are adequate to maintain schedules.
C. Maintain conferences among subcontractors and other concerned parties, as necessary to:
   1. Maintain coordination and schedules.
   2. Resolve matters in dispute.

D. Participate in project meetings:
   1. Report progress of work.
   2. Recommend needed changes in schedule.

E. Temporary Utilities:
   1. Coordinate installation, operation and maintenance, to verify compliance with project requirements and with Contract Documents.
   2. Verify adequacy of service at required locations.

F. Shop Drawings, Product Data and Samples:
   1. Prior to submittal, review for compliance with Contract Documents.
      a. Check field dimensions and clearance dimensions.
      b. Check relation to available space.
      c. Review the effect of any changes on the work of other contracts or trades.
      d. Check compatibility with equipment and work of other trades.

G. Coordination Drawings:
   1. Prepare, as required to assure coordination of work or to resolve conflicts.
   2. Submit for review and transmittal.
   3. Reproduce and distribute approved copies to all concerned parties.
H. Observe required testing; maintain a record of tests:
   1. Testing agency and name of inspector.
   2. Subcontractor.
   3. Manufacturer's representative present.
   4. Date and time of testing.
   5. Type of product or work.
   6. Type of test and results.
   7. Retesting required.

I. Verify that subcontractors maintain accurate record documents.

J. Substitutions and Changes:
   1. Review proposals and requests.
      a. Check for compliance with Contract Documents.
      b. Verify compatibility with work and equipment of other trades.
   2. Promptly report deficiencies or discrepancies to contractor.

K. Assemble documentation for handling of claims or disputes.

L. Equipment Start-Up:
   1. Check to assure that utilities and specified connections are complete and that equipment is in operable condition.
   2. Observe test, adjust and balance.
   3. Record results, including time and date of start-up.

M. Inspection and Acceptance of Work:
   1. Prior to inspection, check that work is complete and ready for acceptance
2. Assist Inspector: Prepare list of items to be completed or corrected.

3. Should acceptance of work constitute the beginning of the specified guarantee period, prepare and transmit written notice to Contractor for the Owner.

N. Assemble record documents from subcontractors.

END OF SECTION 01041
SECTION 01090 - REFERENCE STANDARDS

PART 1 - GENERAL

1.01 SECTION INCLUDES:

A. Quality assurance.

B. Schedule of references.

1.02 QUALITY ASSURANCE:

A. For products or workmanship specified by association, trade, or Federal Standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard by date of issue current on date for receiving bids.

C. Obtain copies of standards when required by Contract Documents.

D. Maintain copy at job site during submittals, planning, and progress of the specific work, until Substantial Completion.

E. Should specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

F. The contractual relationship of the parties to the Contract shall not be altered from the Contract Documents by mention or inference otherwise in any reference document.

1.03 SCHEDULE OF REFERENCE:

AA  Aluminum Association  
900 19th Street, N.W. - Suite 300  
Washington, DC  20006  

AABC  Associated Air Balance Council  
1518 K Street N.W.  
Washington, DC  20005  

AASHTO American Association of State Highway and Transportation Officials  
444 North Capitol Street, N.W. - Suite 249  
Washington, DC  20001
ACI  American Concrete Institute  
P.O. Box 9094  
Farmington Hills, MI 48333-9094

ADC  Air Diffusion Council  
1901 N. Roselle Rd., Suite 800  
Schaumburg, IL 60195

AF&PA  American Forest & Paper Association  
111 19th Street, NW, Suite 800  
Washington, DC 20036

AGC  Associated General Contractors of America  
2300 Wilson Blvd., Suite 400  
Arlington, VA 22201

AI  Asphalt Institute  
2696 Research Park Drive  
Lexington, KY 40511-8480

AIA  American Institute of Architects  
1735 New York Avenue, N.W.  
Washington, DC 20006-5292

AISC  American Institute of Steel Construction  
One East Wacker Drive  
Suite 3100  
Chicago, IL 60601-2001

AISI  American Iron and Steel Institute  
1140 Connecticut Ave - Suite 705  
Washington, DC 20036

AITC  American Institute of Timber Construction  
7012 S. Revere Parkway - Suite 140  
Englewood, CO 80112

AMCA  Air Movement and Control Association  
30 West University Drive  
Arlington Heights, IL 60004

ANSI  American National Standards Institute  
25 West 43rd Street, Fourth Floor  
New York, NY 10036

APA  American Plywood Association  
Box 11700  
Tacoma, WA 98411-0700
ARI  Air Conditioning and Refrigeration Institute  
4100 North Fairfax Drive - Suite 200  
Arlington, VA 22203

ASHRAE  American Society of Heating, Refrigeration and  
Air Conditioning Engineers  
1791 Tullie Circle, N.E.  
Atlanta, GA 30329

ASME  American Society of Mechanical Engineers  
Three Park Avenue  
New York, NY 10016-5990

ASTM  American Society for Testing and Materials  
100 Barr Harbor Drive  
West Conshohocken, PA 19428-2959

AWI  Architectural Woodwork Institute  
46179 Westlake Drive, Suite 120  
Potomac Falls, VA 20165

AWPA  American Wood-Preservers' Association  
P.O. Box 5690  
Grandbury, TX 76049

AWS  American Welding Society  
550 N.W. LeJeune Road  
Miami, FL 33126

AWWA  American Water Works Association  
6666 West Quincy Avenue  
Denver, CO 80235

BIA  Brick Institute of America  
1350 Centennial Park Drive, Suite 301  
Reston, VA 20191

CDA  Copper Development Association  
260 Madison Avenue - 16th Floor  
New York, NY 10016

CLFMI  Chain Link Fence Manufacturers Institute  
10015 Old Columbia Road, Suite B-215  
Columbia, MD 21046

CRSI  Concrete Reinforcing Steel Institute  
933 Plum Grove Road  
Schaumburg, IL 60173-4758
CSSB  Cedar Shake and Shingle Bureau  
P.O. Box 1178  
Sumas, WA 98295-1178

DHI  Door and Hardware Institute  
14150 Newbrook Drive, Suite 200  
Chantilly, VA 20151

EJCDC  Engineers' Joint Contract Documents Committee  
American Council of Engineering Companies  
1015 15th Street, N.W., 8th Floor  
Washington, DC 20005

EJMA  Expansion Joint Manufacturers Association  
25 North Broadway  
Tarrytown, NY 10591

FGMA  Flat Glass Marketing Association  
3310 Harrison  
White Lakes Professional Building  
Topeka, KS 66611

FM  Factory Mutual System  
Standards Laboratories Department  
1151 Boston-Providence Turnpike  
Norwood, MA 02062

FS  Federal Specification  
General Services Administration  
Specifications and Consumer Information  
Distribution Section (WFSIS)  
1800 F Street, NW  
Washington, DC 20405

GA  Gypsum Association  
810 First Street N.W. #510  
Washington, DC 20002-4268

ICC  International Code Council  
5203 Leesburg Pike, Suite 600  
Falls Church, VA 22041

IEEE  Institute of Electrical and Electronics Engineers  
345 East 47th Street  
New York, NY 10017

IMIAC  International Masonry Industry All-Weather Council  
International Masonry Institute  
815 15th Street, N.W.  
Washington, DC 20005
MBMA  Metal Building Manufacturer's Association  
1300 Sumner Avenue  
Cleveland, OH  44115-2351

MFMA  Maple Flooring Manufacturers Association  
60 Revere Drive  
Northbrook, IL  60062

MIL  Military Specification  
Naval Publications and Forms Center  
700 Robbins Avenue, Building 4, Section D  
Philadelphia, PA  19111-5093

ML/SFA  Metal Lath/Steel Framing Association  
Division of National Association of Architectural Metal Manufacturers (NAAMM MLIFSA)  
600 South Federal Street, Suite 400  
Chicago, IL  60605

NAAMM  National Association of Architectural Metal Manufacturers  
800 Roosevelt Road, Building C, Suite 312  
Glen Ellyn, IL  60137

NCMA  National Concrete Masonry Association  
2302 Horse Pen Road  
Herndon, VA  22071-3499

NEBB  National Environmental Balancing Bureau  
8575 Grovement Circle  
Gaithersburg, MD  20877

NEMA  National Electrical Manufacturers' Association  
1300 North 17th Street, Suite 1752  
Rosslyn, VA  22209

NFPA  National Fire Protection Association  
#1 Battery March Park  
Quincy, MA  02269-9101

NSWMA  National Solid Wastes Management Association  
4301 Connecticut Avenue, N.W., Suite 300  
Washington, DC  20008-2304

NTMA  National Terrazzo and Mosaic Association  
201 North Maple, Suite 208  
Purcellville, VA  20132
PCA  Portland Cement Association  
5420 Old Orchard Road  
Skokie, IL  60077

PCI  Precast Prestressed Concrete Institute  
175 W. Jackson Blvd.-Suite 1859  
Chicago, IL  60604-9773

PS  Product Standard  
U.S. Department of Commerce  
1401 Constitution Avenue, N.W.  
Washington, DC  20230

RIS  Redwood Inspection Service  
Division of California Redwood Association  
405 Enfrente Drive  
Novato, CA  94949

SDI  Steel Deck Institute  
P.O. Box 25  
Fox River Grove, IL  60021

SDI  Steel Door Institute  
c/o Wherry Associates  
30200 Detroit Road  
Cleveland, OH  44145-1967

SIGMA  Sealed Insulating Glass Manufacturers Association  
401 N. Michigan Avenue  
Chicago, IL  60611

SJI  Steel Joist Institute  
3127 10th Avenue North  
Myrtle Beach, SC  29577-6760

SMACNA  Sheet Metal and Air Conditioning Contractors'  
National Association  
4201 Lafayette Center Drive  
Chantilly, VA  20151-1209

SSPC  Society for Protective Coatings  
40 24th Street, 6th Floor  
Pittsburgh, PA  15222-4656

TCNA  Tile Council of North America, Inc.  
100 Clemson Research Blvd.  
Anderson, SC  29625
TPI Turfgrass Producers International
2 East Main Street
East Dundee, IL 60118

UL Underwriters' Laboratories, Inc.
333 Pfingston Road
Northbrook, IL 60062-2096

WCLIB West Coast Lumber Inspection Bureau
6980 S.W. Varns Road
Tigard, OR 97223

WDMA Window & Door Manufacturers Associations
1400 W. Touhy Avenue, Suite 470
Des Plaines, IL 60018

WWPA Western Wood Products Association
522 SW Fifth Avenue, Suite 500
Portland, OR 97204-2122

PART 2 - PRODUCTS
Not Used

PART 3 - EXECUTION
Not Used

END OF SECTION 01090
PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. This section identifies each Alternate by number, and describes the basic changes to be incorporated into the work, only when the Alternate is made a part of the work by specific provisions in the Owner-Contractor Agreement.

B. Alternate schedule below is part of the Bidding Documents and will be considered in selection of Contractors and awarding contracts.

C. Unless otherwise provided, Owner will accept or reject alternates within one hundred twenty (120) days of date of contract. Owner reserves the right to reject any or all alternates.

1.03 ALTERNATES:

A. General:

1. The descriptions for each alternate listed in the schedule are primarily scope definitions, and do not necessarily detail the full range of materials and processes needed to complete the work as required.

2. Refer to applicable specification sections (Division 2 through 16), and to applicable drawings, for specific requirements of the work, regardless of whether references are so noted in description of each alternative.

3. Coordinate pertinent related work and modify surrounding work as required to properly integrate the work under each Alternate, and to provide the complete construction required by Contract Documents.

4. Referenced sections of specifications stipulate pertinent requirements for products and methods to achieve the work stipulated under each Alternate.
B. Schedule:

1. **Alternate No. 1:** Provide costs to provide at risk construction management services in lieu of base proposal. General conditions shall include all required to complete the project. See below list of general conditions to include (but not necessarily limited to).

1. Pre-Development Fees (estimating, scheduling, VE, constructability reviews)
2. Utilities
3. Office Trailers
4. Vehicles
5. Lay-Down Yard / Staging / Temp Access
6. Dumpsters
7. SWPPP (Soil Erosion)
8. Mobilization and Demobilization
9. Drinking Water
10. Clean-Up
11. Project Staff and Admin Wages (Including Overtime, if Needed)
12. Tools / Equipment
13. Superintendent(s)
14. Safety Manager
15. Project Scheduler and estimators
16. QA / QC Manager
17. Project Manager(s) and Staff
19. Temp Site Signage
20. Street Sweeping
21. Temporary Lighting
22. As-Built and Record Document Preparation
23. PPE for Staff and Visitors
24. First Aid
25. Safety Program Administration and Training
26. Material Delivery Costs
27. Building Permit Costs and Governmental Required Fees
28. Communication Systems
29. Temp Building Insurances, Ramps, and Structures
30. Fire Protection
31. Bonds and Insurance for project
32. Temp Barriers / Securing of Site
33. Close out Documents and Procedures
34. Office equipment, phones, and other office supplies
35. Temporary toilets
36. All cleaning

END OF SECTION 01100
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies administrative and procedural requirements for project meetings including but not limited to:
   1. Pre-Construction Conference.
   2. Pre-Installation Conferences.
   3. Coordination Meetings.
   4. Progress Meetings.

B. Construction schedules are specified in Specification Section 01310.

1.3 PRE-CONSTRUCTION CONFERENCE

A. Schedule a pre-construction conference and organizational meeting at the Project site or other convenient location no later than (14) days after execution of the Agreement and prior to commencement of construction activities. Conduct the meeting to review responsibilities and personnel assignments.

B. Attendees: The Owner, Architect and their consultants, the Contractor and its superintendent, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with and authorized to conclude matters relating to the work.

C. Agenda: Discuss items of significance that could affect progress including such topics as:

   1. Tentative construction schedule.
   2. Critical work sequencing.
   3. Designation of responsible personnel.
   4. Procedures for processing field decisions and Change Orders.
   5. Procedures for processing Applications for Payment.
7. Submittal of Shop Drawings, Product Data and Samples.
8. Preparation of record documents.
9. Use of the premises.
10. Office, Work and storage areas.
11. Equipment deliveries and priorities.
12. Safety procedures.
13. First aid.
15. Housekeeping.
16. Working hours.

1.4 PRE-INSTALLATION CONFERENCES

A. Conduct a pre-installation conference at the site before each construction activity that requires coordination with other construction. The Installer and representatives of manufacturers and fabricators involved in or affected by the installation, and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise the Architect of scheduled meeting dates.

1. Review the progress of other construction activities and preparations for the particular activity under consideration at each pre-installation conference, including requirements for:

   b. Options.
   c. Related Change Orders.
   d. Purchases
   e. Deliveries.
   f. Shop Drawings, Product Data and quality control Samples.
   g. Possible conflicts.
   h. Compatibility problems.
   i. Time schedules.
   j. Weather limitations.
   k. Manufacturer's recommendations.
   l. Compatibility of materials.
   m. Acceptability of substrates.
   n. Temporary facilities.
   o. Space and access limitations.
   p. Governing regulations.
   q. Safety.
   r. Inspection and testing requirements.
   s. Required performance results.
   t. Recording requirements.
   u. Protection.
2. Record significant discussions and agreements and disagreements of each conference, along with the approved schedule. Distribute the record of the meeting to everyone concerned, promptly, including the Owner and Architect.

3. Do not proceed if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of Work and reconvene the conference at the earliest feasible date.

1.5 COORDINATION MEETINGS

A. Conduct Project coordination meetings at regularly scheduled times convenient for all parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation meetings.

B. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.

C. Record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

1.6 PROGRESS MEETINGS

A. Conduct progress meetings at the Project site at regularly scheduled intervals. Notify the Owner and Architect of scheduled meeting dates. Coordinate dates of meetings with preparation of the payment request.

B. Attendees: In addition to representatives of the Owner and Architect, each subcontractor, supplier or other entity concerned with current progress or involved in planning, coordination or performance of future activities shall be represented at these meetings by persons familiar with the Project and authorized to conclude matters relating to progress.

C. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project.
1. Contractor's Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Contractor's Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

2. Review the present and future needs of each entity present, including such items as:
   a. Interface requirements.
   b. Time.
   c. Sequences.
   d. Deliveries.
   e. Off-site fabrication problems.
   f. Access.
   g. Site utilization.
   h. Temporary facilities and services.
   i. Hours of Work.
   j. Hazards and risks.
   k. Housekeeping.
   l. Quality and Work standards.
   m. Change Orders.
   n. Documentation of information for payment requests.

D. Reporting: No later than (3) days after each progress meeting date, distribute copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report.

1. Schedule Updating: Revise the construction schedule after each progress meeting where revisions to the schedule have been made or recognized. Issue the revised schedule concurrently with the report of each meeting.
SECTION 01310 - CONSTRUCTION SCHEDULES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to other Sections of Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF REQUIREMENTS:

A. General: This section specifies the particular administrative and procedural requirements for progress time scheduling and progress reporting for the performance of the work, as indicated in the General Conditions and elsewhere in the Contract Documents. Refer also to the General Conditions and to the "Contractor" for definition and specific dates of the Contract Time.

B. Scheduling Responsibility: Submission of Contractor's progress schedule to the Owner or Architect shall not relieve the Contractor of his total responsibility for the requirements of the Contract Documents, including adverse effects such as delays resulting from ill-timed work; refer to General Conditions.

1.03 FORM OF SCHEDULES:

A. Contractor shall prepare a "Plan of Operations and Progress Schedule" which shall show concisely the manner in which different phases of the work are to be started, methods and speed for the inter-relationship of the work under the various contracts, times upon which different phases of the work are to be started, methods and speed for progressing the different phases and dates upon which the certain subcontractors are dependent upon that under other subcontracts.

B. The plan of operations and progress schedule shall be "weighed" to schedule each trade in proportion to the entire project, both physically and financially.

C. In preparing the above plan of operations and progress schedule, the Contractor shall assure that the methods, dates and other pertinent matters are acceptable to the Architect and, when completed, he shall submit to and obtain approval from the Architect and Owner.
D. After approval of the above plan of operations and progress schedule, the Contractor shall be responsible for seeing that it is adhered to and for ascertaining that proper coordination is maintained between work of all Contracts.

1.04 PROGRESS REVISIONS:
A. Indicate progress of each activity to date of submission.
B. Show changes occurring since previous submission of schedule:
   1. Major changes in scope.
   2. Activities modified since previous submission.
   3. Revised projections of progress and completion.
   4. Other identifiable changes.
C. Provide a narrative report as needed to define:
   1. Problem areas, anticipated delays, and the impact on the schedule.
   2. Corrective action recommended and its effect.
   3. The effect of changes on schedules of other contractors.

1.05 SUBMISSIONS:
A. Submit initial schedules within 14 days after award of Contract.
   1. Architect and Owner will review schedules and return review copy within (10) days after receipt.
   2. Resubmit within (10) days after return of review copy.
B. Submit a revised and updated progress schedule and narratives with each application for payment, but not less than once a month until project is complete.

1.06 DISTRIBUTION:
A. Distribute copies of the reviewed schedules and narratives to:
2. Subcontractors.
3. Other concerned parties.

B. Instruct recipients to report promptly to the Contractor, in writing, any problems anticipated by the projections shown in the schedules.

1.07 DAILY REPORTS:

A. Contractor shall prepare a daily report, recording the following information concerning events at the site and submit duplicate copies to the Architect and Owner at regular intervals not exceeding weekly intervals.

1. List of subcontractors at the site.
2. List of separate contractors at the site.
3. Count of personnel at the site.
4. High/low temperatures, general weather conditions.
5. Accidents (refer to accident reports).
6. Meetings and significant decisions.
7. Unusual events.
8. Stoppages, delays, shortages, losses.
10. Orders/requests by governing authorities.
11. Change orders received, implemented.

PART 2 and 3 - PRODUCTS AND EXECUTION - Not Applicable

END OF SECTION 01310
SECTION 01340 - SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to other Sections of Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION:

A. Submit shop drawings, product data and samples as required by the Contract Documents. Individual submittal requirements are specified in applicable sections for each unit of work. Receive, check and coordinate all submittals of contractors as provided herein.

B. Definitions:

1. Shop Drawings are drawings, diagrams, schedules and other data specifically prepared for the Work by the Contractor or any subcontractor, manufacturer, supplier or distributor to illustrate some portion of the Work.

2. Product Data are illustrations, standard schedules, performance charts, instructions, brochures, diagrams and other information furnished by the Contractor to illustrate a material, product or system for some portion of the Work.

3. Samples are physical examples which illustrate materials, equipment or workmanship and establish standards by which the work will be judged.

1.03 SUBMITTAL REQUIREMENTS:

A. Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittals. Coordinate and sequence different categories of submittals for the same work, and for interfacing units of work, so that one will not be delayed for coordination with another. No extension of time will be allowed because of failure to properly coordinate and sequence submittals.

B. Submit minimum one reproduction transparency and the two (2) prints of each shop drawing, including fabrication, erection, layout and setting drawings and such other drawings as required under various sections of the Specifications, until
final acceptance is obtained. Prepare drawings legible, drawing plans, elevations, sections and details in scales required and on drawing sheets not larger than 30" x 42" nor smaller than 24" x 30". Submit copies of manufacturer's descriptive data including catalog sheets for materials, equipment and fixtures, showing dimensions, performance characteristics and capacities, wiring diagrams and controls, schedules, and other pertinent information as required. Where printed materials describe more than one product or model, clearly identify which is to be furnished.

C. Shop drawings, product data and samples shall be dated including Contractor and Subcontractor dates of submittal and approval, and marked to show the names of the Project, Architect, Contractor, origination Subcontractor, manufacturer or supplier, and separate detailer if pertinent. Shop drawings shall completely identify Specification section and locations at which materials or equipment are to be installed. Reproductions of Contract Drawings are acceptable as Shop Drawings only when specifically authorized in writing by the Architect.

D. Submission of shop drawings, product data and samples shall be accompanied by a copy of a transmittal letter containing Project name, Contractor's name, number of drawings, and samples, titles and other pertinent data. Transmittal shall bear signature of the Contractor as evidence he checked same and found them in conformance with the Contract Documents.

E. The Contractor shall review, approve and submit, with reasonable promptness and in such sequence as to cause no delay in the Work or in the work of the Owner or any separate contractor, all Shop Drawings, Product Data and Samples required by the Contract Documents.

F. By approving and submitting Shop Drawings, Product Data and Samples, the contractor represents that he has determined and verified all materials, field measurements, and field construction criteria related thereto, or will do so, and that he has checked and coordinated the information contained within such submittals with the requirements of the Work and of the Contract Documents.

G. The Contractor shall not be relieved of responsibility for the deviation from the requirements of the Contract Documents by the Architect's acceptance of Shop Drawings, Product Data or Samples under Paragraph 13.12 of the General Conditions, unless the Contractor has specifically informed the Architect in writing of such deviation at the time of sub-deviation.
The Contractor shall not be relieved from responsibility for errors or omissions in the Shop Drawings, Product Data or Samples by the Architect's acceptance thereof.

H. The Contractor shall direct specific attention, in writing or on resubmitted Shop Drawings, Product Data or Samples, to revisions other than those requested by the Architect on previous submittals.

I. No portion of the Work requiring submission of a Shop Drawing, Product Data or Sample shall be commenced until the submittal has been accepted by the Architect as provided in Paragraph 13.12 of the General Conditions. All such portions of the Work shall be in accordance with approved submittals.

J. Architect will review Shop Drawings, Product Data and Samples as provided in Paragraph 13.12 of the General Conditions. He will mark each such submittal as follows:

1. Accepted - Where no comment made.

2. Accepted as Noted - Where comments indicated on submittal qualifying, modifying, or otherwise changing it; however, submittal can be used for ordering, fabrication and erection at contractor's own risk until revised submittals have been made, reviewed and stamped acceptable.

3. Not Accepted - Submittal not in conformance; revise and resubmit. Acceptance does not authorize any changes in the Contract Documents unless specifically stated in a separate letter or change order.

K. Contractor is responsible for obtaining and distributing required prints of shop drawings to his subcontractors and material suppliers; after as well as before final approval. Prints of reviewed shop drawings shall be made from transparencies which carry the Architect's appropriate stamp.

L. Obtain copies of all shop drawings, product data and samples submitted to date and accepted from other contractors.

PARTS 2 and 3 - PRODUCT AND EXECUTION

Not applicable.

END OF SECTION 01340
SECTION 01370 - SCHEDULE OF VALUES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Requirements, and to other Sections of Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. Submit to the Architect a Schedule of Values allocated to the various portions of the work, within ten days after award of contract.

B. Upon request of the Architect, support the values with data which will substantiate their correctness.

C. The Schedule of Values, unless objected to by the Architect or Owner, shall be used only as the basis for the Contractor's Applications for Payment.

1.03 FORM AND CONTENT OF SCHEDULE OF VALUES:

A. Use AIA Forms G702 and G702A or forms provided by Owner.

B. Schedule shall list the installed value of the component parts of the work in sufficient detail to serve as a basis for computing values for progress payments during construction.

C. Follow the table of contents of Sections as the format for listing component items.

1. Identify each line item with the number and title of the respective major section of the specifications.

D. For each major line item list sub-values of major products or operations under the item.

1. Each item shall include a directly proportional amount of the Contractor's overhead and profit.

E. The sum of all values listed in the schedules shall equal the total Contract Sum.

PARTS 2 AND 3 - PRODUCTS AND EXECUTION - Not Applicable

END OF SECTION 01370
SECTION 01400 - QUALITY CONTROL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION:

A. Specific quality control requirements for the work are indicated throughout the contract documents. The term "Quality Control" includes, but is not necessarily limited to, inspection and testing and associated requirements. This section does not specify or modify Architect's duties relating to quality control and Contract enforcement.

B. Coordinate quality control programs of separate contractors including submittals, conferences and on site programs.

1.03 RESPONSIBILITY:

A. Residual Contractor Responsibility: Whatever required, inspection, testing and similar quality control provisions to be performed by independent agencies (not directly by the Contractor), and not indicated to be Owner's responsibility, shall be the Contractor's responsibility. The costs for those required services by independent testing laboratories are recognized to be included in Contract Sum.

B. Contractor's General Responsibility: No failure of test agencies, whether engaged by Owner or Contractor, to perform adequate inspections or tests or to properly analyze or report results, shall relieve Contractor of responsibility for fulfillment of requirements of contract documents. It is recognized that required inspection and testing program is intended to assist the Contractor, Owner, Architect, and governing authorities in nominal determination of probable compliances with requirements for certain elements of work. The program is not intended to limit the Contractor's regular quality control program, as needed for general assurance of compliances.
1.04 QUALITY ASSURANCE:

A. General Workmanship Standards: Comply with recognized workmanship quality standards within the industry as applicable to each unit of work, including ANSI standards where applicable. It is a requirement that each category of trades person or installer performing the work be prequalified, to the extent of being familiar with applicable and recognized quality standards for that category of work, and being capable of workmanship complying with those standards.

B. Qualification of Quality Control Agencies: Except where another qualification standard is indicated, and except where it is specifically indicated that use of prime product manufacturer's test facilities is acceptable, engage independent testing laboratories complying with "Recommended Requirements for Independent Laboratory Qualifications" as published by American Council of Independent Laboratories, and specializing in type(s) of inspections and tests required.

1.05 SUBMITTALS:

A. General: Refer to Section 01340, “Shop Drawings, Product Data and Samples” for requirements applicable to inspection and test reports, quality control samples, maintenance agreements, warranties, and similar documentation of quality compliances as required. Refer to individual work sections of Division 2 through 16 for specific certification and submittal requirements.

B. Copies and Distribution: Where inspection and test reports and certifications are required by governing authorities, provide additional copies as required, and where required, send copies directly from inspection or testing agency to governing authority.

1.06 PRODUCT DELIVERY, STORAGE, AND HANDLING:

A. General: Handle, store and protect materials and products, including fabricated components, by methods and means which will prevent damage, deterioration and losses including theft (and resulting delays), thereby ensuring highest quality results as performance of the work progresses. Control delivery schedules so as to minimize unnecessary long-term storage at project site prior to installation.
PART 3 - EXECUTION:

3.01 PREPARATION FOR INSTALLATION:

A. Pre-Installation Conferences: Well in advance of installation of every major unit of work which requires coordination with other work, meet at the project site with installers and representatives of manufacturers and fabricators who are involved in or affected by the unit of work, and in its coordination or integration with other work which has proceeded or will follow. Advise Architect and Owner of scheduled meeting dates. At each meeting, review progress of other work and preparations for particular work under consideration, including requirements of contract documents, options, related change orders, purchases, deliveries, shop drawings, product data, quality control samples, possible conflicts, compatibility problems, time schedule, weather limitations, temporary facilities, space and access limitations, structural limitations, governing regulations, safety, inspection and testing requirements required performance results, recording requirements, and protection. Record significant discussions of each conference, and agreements and disagreements along with final plan of action. Distribute record of meeting promptly to everyone concerned, including Architect and Owner.

1. Do not proceed with the work if associated pre-installation conference cannot be concluded successfully. Instigate actions to resolve impediments to performance of the work, and reconvene conference at earliest data feasible.

B. Installer's Inspection of Conditions: Require Installer of each major unit of work to inspect substrate to receive the work, and conditions under which the work will be performed, and to report (in writing to the Contractor) unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
3.02 COORDINATION OF TEST AGENCY WORK:

A. Coordination with Owner's Agencies: Afford access and reasonable time in construction sequence for Owner's inspection and tests to be performed. Cooperate with agencies and provide incidental labor and services needed for the removal and delivery of test samples, and for inspections and taking measurements. Provide patching and restoration services where test samples have been removed, complying with individual technical sections of Divisions 2 through 16.

1. Except for specialized laboratory sampling equipment, and except as otherwise indicated, supply and operate tools and construction equipment needed to obtain test samples from the work, including cutting devices for sawing, drilling, flame-cutting, coring and similar operations. Assist agencies in labeling and packing of test samples removed from the work.

B. Coordination with Contractor's Independent Agencies: Except for required independent agency activities of inspection, measuring, testing, analyzing, reporting and similar activities, the assignment of labor, equipment, cutting, Patching and similar necessary activities associated therewith are Contractor's option recognizing that entire activity is Contractor's responsibility.

C. Test Agency Responsibilities:

1. Test agencies, regardless of whether engaged by Owner or Contractor, are not authorized to change or negate requirements of Contract Documents. Each agency shall coordinate its assigned work with construction schedule as maintained by Contractor, and shall perform its work promptly so as not to delay the work. Observances (by agencies) having a bearing on the work shall be reported to Architect in most expeditious way possible, and shall be recorded in writing by agency. Agency personnel shall not interfere with or assume duties of Contractor.

2. Reports: The testing agency shall prepare reports of inspections and laboratory tests, including analysis and interpretation of test results where applicable. Properly identify each report and, where required, provide agency's certification of test results. Describe test methods used, and compliance with recognized test standards (if any). Complete and submit report at earliest possible date in each case.
3.03 INSTALLATION QUALITY CONTROL:

A. Manufacturer's Instructions: Where installations include manufactured products, comply with manufacturer's applicable instructions and recommendations for installation, to whatever extent these are more explicit or more stringent than applicable requirements indicate in contract documents.

B. Inspect each item of materials or equipment, immediately prior to installation, and reject damaged and defective items.

C. Provide attachment and connection devices and methods for securing work properly as it is installed; true to line and level, and within recognized industry tolerances, if not otherwise indicated. Allow for expansions and building movements. Provide uniform joint widths in exposed work, organized for best possible visual effect. Refer questionable visual effect choices to Architect for final decision.

D. Recheck measurements and dimensions of the work, as an integral step of starting each installation.

E. Install work during conditions of temperature, humidity, exposed, forecasted weather, and status of project completion which will ensure best possible results for each unit of work, in coordination with entire work. Isolate each unit of work from non-compatible work, as required to prevent deterioration.

F. Coordinate enclosure (closing-in) of work with required inspections and tests, so as to avoid necessity of uncovering work for that purpose.

G. Mounting Heights: Except as otherwise indicated, mount individual units of work at industry-recognized standard mounting heights, for applications indicated. Refer questionable mounting height choices to Architect for final decision.

H. Adjust, clean, lubricate, restore, marred finished, and protect newly installed work, to ensure that it will remain without damage or deterioration during the remainder of construction period.

END OF SECTION 01400
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division-1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section specifies requirements for temporary services and facilities, including utilities, construction and support facilities, security and protection.

B. Temporary utilities required include but are not limited to:
   1. Water service and distribution.
   2. Temporary electric power and light.
   3. Telephone service.

C. Temporary construction and support facilities required include but are not limited to:
   1. Temporary heat.
   2. Field offices and storage sheds.
   3. Temporary roads and paving.
   4. Sanitary facilities, including drinking water.
   5. Temporary enclosures.
   6. Hoists and temporary elevator use.
   7. Temporary Project identification signs and bulletin boards.
   8. Waste disposal services.
   9. Construction aids and miscellaneous services and facilities.

D. Security and protection facilities required include but are not limited to:
   1. Temporary fire protection.
   2. Barricades, warning signs, lights.
   3. Sidewalk bridge or enclosure fence for the site.
   4. Environmental protection.
1.3 SUBMITTALS

A. Temporary Utilities: Submit reports of tests, inspections, meter readings and similar procedures performed on temporary utilities.

1.4 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations if authorities having jurisdiction, including but not limited to:

1. Building Code requirements.
2. Health and safety regulations.
3. Utility company regulations.
4. Police, Fire Department and Rescue Squad rules.
5. Environmental protection regulations.


1. Refer to "Guidelines for Bid Conditions for Temporary Job Utilities and Services", prepared jointly by AGC and ASC, for industry recommendations.
2. Electrical Service: Comply with NEMA, NECA and UL standards and regulations for temporary electric service. Install service in compliance with National Electric Code (NFPA 70).

C. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.5 PROJECT CONDITIONS

A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner, change over from use of temporary service to use of the permanent service.
B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities, or permit them to interfere with progress. Do not allow hazardous dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide new materials; if acceptable to the Architect, undamaged previously used materials in serviceable condition may be used. Provide materials suitable for the use intended.

B. Lumber and Plywood: Comply with requirements in Section 06100 "Carpentry."

1. For job-built temporary offices, shops and sheds within the construction area, provide UL labeled, fire treated lumber and plywood for framing, sheathing and siding.

2. For signs and directory boards, provide exterior type, Grade B-B High Density Concrete Form Overlay Plywood conforming to PS-1, of sizes and thickness indicated.

3. For fences and vision barriers, provide exterior type, minimum 3/8" thick plywood.

4. For safety barriers, sidewalk bridges and similar uses, provide minimum 5/8" thick exterior plywood.

C. Paint: Comply with requirements of Division-9 Section "Finish Painting."

1. For job-built temporary offices, shops, sheds, fences and other exposed lumber and plywood, provide exterior grade acrylic-latex emulsion over exterior primer.

2. For sign panels and applying graphics, provide exterior grade alkyd gloss enamel over exterior primer.
D. Tarpaulins: Provide waterproof, fire-resistant, UL labeled tarpaulins with flame-spread rating of 15 or less. For temporary enclosures provide translucent nylon reinforced laminated polyethylene or polyvinyl chloride fire retardant tarpaulins.

E. Water: Provide potable water approved by local health authorities.

F. Open-Mesh Fencing: Provide 11-gage, galvanized 2-inch, chain link fabric fencing 6-feet high with galvanized barbed wire top strand and galvanized steel pipe posts, 1-1/2" I.D. for line posts and 2-1/2" I.D. for corner posts. Contractor may reuse existing construction fence where present, but will be responsible for all repairs necessary to bring it into compliance with this section.

2.2 EQUIPMENT

A. General: Provide new equipment; if acceptable to the Architect, undamaged, previously used equipment in serviceable condition may be used. Provide equipment suitable for use intended.

B. Water Hoses: Provide 3/4" heavy-duty, abrasion-resistant, flexible rubber hoses 100 ft. long, with pressure rating greater than the maximum pressure of the water distribution system; provide adjustable shut-off nozzles at hose discharge.

C. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.

D. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords, if single lengths will not reach areas where construction activities are in progress.

E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.
F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM or another recognized trade association related to the type of fuel being consumed.

G. Temporary Offices: Provide prefabricated or mobile units or similar job-built construction with lockable entrances, operable windows and serviceable finishes. Provide heated and air-conditioned units on foundations adequate for normal loading.

H. Temporary Toilet Units: Provide self-contained single-occupant toilet units of the chemical, aerated recirculation, or combustion type, properly vented and fully enclosed with a glass fiber reinforced polyester shell or similar nonabsorbent material.

I. First Aid Supplies: Comply with governing regulations.

J. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures.

1. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use qualified personnel for installation of temporary facilities. Locate facilities where they will serve the Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required.

B. Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed, or are replaced by authorized use of completed permanent facilities.
3.2 TEMPOARY UTILITY INSTALLATION

A. General: Engage the appropriate local utility company to install temporary service or connect to existing service. Where the company provides only part of the service, provide the remainder with matching, compatible materials and equipment; comply with the company's recommendations.

1. Arrange with the company and existing users for a time when service can be interrupted, where necessary, to make connections for temporary services.

2. Provide adequate capacity at each stage of construction. Prior to temporary utility availability, provide trucked-in services.

3. Use Charges: Cost or use charges for temporary facilities are not chargeable to the Owner or Architect, and will not be accepted as a basis of claims for a Change Order.

B. Water Service: Install water service and distribution piping of sizes and pressures adequate for construction until permanent water service is in use.

1. Sterilization: Sterilize temporary water piping prior to use.

C. Temporary Electric Power Service: Provide weatherproof, grounded electric power service and distribution system of sufficient size, capacity, and power characteristics during construction period. Include meters, transformers, overload protected disconnects, automatic ground-fault interrupters and main distribution switch gear.

1. Except where overhead service must be used, install electric power service underground.

2. Power Distribution System: Install wiring overhead, and rise vertically where least exposed to damage. Where permitted, wiring circuits not exceeding 125 Volts, AC 20 ampere rating, and lighting circuits may be nonmetallic sheathed cable where overhead and exposed for surveillance.

D. Temporary Lighting: Whenever overhead floor or roof deck has been installed, provide temporary lighting with local switching.
1. Install and operate temporary lighting that will fulfill security and protection requirements, without operating the entire system, and will provide adequate illumination for construction operations and traffic conditions.

E. Temporary Telephones: Provide temporary telephone service for all personnel engaged in construction activities, throughout the construction period. Install telephone on a separate line for each temporary office and first aid station. Where an office has more than two occupants, install a telephone for each additional occupant or pair of occupants.

1. At each telephone, post a list of important telephone numbers.

F. Sewers and Drainage: If sewers are available, provide temporary connections to remove effluent that can be discharged lawfully. If sewers are not available or cannot be used, provide drainage ditches, dry wells, stabilization ponds and similar facilities. If neither sewers nor drainage facilities can be lawfully used for discharge of effluent, provide containers to remove and dispose of effluent off the site in a lawful manner.

1. Filter out excessive amounts of soil, construction debris, chemicals, oils and similar contaminants that might clog sewers or pollute waterways before discharge.

2. Connect temporary sewers to the municipal system as directed by the sewer department officials.

3. Maintain temporary sewers and drainage facilities in a clean, sanitary condition. Following heavy use, restore normal conditions promptly.

G. Provide earthen embankments and similar barriers in and around excavations and subgrade construction, sufficient to prevent flooding by runoff of storm water from heavy rains.

3.3 TEMPORARY CONSTRUCTION AND SUPPORT FACILITIES INSTALLATION

A. Locate field offices, storage sheds, sanitary facilities and other temporary construction and support facilities for easy access.
1. Maintain temporary construction and support facilities until near Substantial Completion. Remove prior to Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to the Owner.

B. Provide incombustible construction for offices, shops and sheds located within the construction area, or within 30 feet of building lines. Comply with requirements of NFPA 241.

C. Temporary Heat: Provide temporary heat required by construction activities, for curing or drying of completed installations or protection of installed construction from adverse effects of low temperatures or high humidity. Select safe equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce the ambient condition required and minimize consumption of energy.

D. Heating Facilities: Except where use of the permanent system is authorized, provide vented self-contained LP gas or fuel oil heaters with individual space thermostatic control.
   1. Use of gasoline-burning space heaters, open flame, or salamander type heating units is prohibited.

E. Field Offices: Provide insulated, weathertight temporary offices of sufficient size to accommodate required office personnel at the Project site. Keep the office clean and orderly for use for small progress meetings. Furnish and equip offices as follows:
   1. Furnish with a desk and chairs, a 4-drawer file cabinet, plan table and plan rack and a 6-shelf bookcase.
   2. Equip with a water cooler and private toilet complete with water closet, lavatory and mirror-medicine cabinet unit.

F. Storage and Fabrication Sheds: Install storage and fabrication sheds, sized, furnished and equipped to accommodate materials and equipment involved, including temporary utility service. Sheds may be open shelters or fully enclosed spaces within the building or elsewhere on the site.
G. Temporary Paving: Construct and maintain temporary roads and paving to adequately support the indicated loading and to withstand exposure to traffic during the construction period. Locate temporary paving for roads, storage areas and parking where the same permanent facilities will be located. Review proposed modifications to permanent paving with the Architect.

1. Paving: Comply with Section 02760 “Hot Mix Asphalt Paving” for construction and maintenance of temporary paving.

2. Coordinate temporary paving development with subgrade grading, compaction, installation and stabilization of subbase, and installation of base and finish courses of permanent paving.

3. Install temporary paving to minimize the need to rework the installations and to result in permanent roads and paved areas that are without damage or deterioration when occupied by the Owner.

4. Delay installation of the final course of permanent asphalt concrete paving until immediately before Substantial Completion. Coordinate with weather conditions to avoid unsatisfactory results.

5. Extend temporary paving in and around the construction area as necessary to accommodate delivery and storage of materials, equipment usage, administration and supervision.

H. Sanitary facilities include temporary toilets, wash facilities and drinking water fixtures. Comply with regulations and health codes for the type, number, location, operation and maintenance of fixtures and facilities. Install where facilities will best serve the Project’s needs.

1. Provide toilet tissue, paper towels, paper cups and similar disposable materials for each facility. Provide covered waste containers for used material.

I. Toilets: Use of the Owner's existing toilet facilities will not be permitted.

J. Toilets: Install self-contained toilet units. Shield toilets to ensure privacy. Use of pit-type privies will not be permitted.
K. Drinking Water Fixtures: Provide drinking water fountains where indicated, including paper supply.

L. Dewatering Facilities and Drains: For temporary drainage and dewatering facilities and operations not directly associated with construction activities included under individual Sections, comply with dewatering requirements of applicable Division-2 Sections. Where feasible, utilize the same facilities. Maintain the site, excavations and construction free of water.

M. Temporary Enclosures: Provide temporary enclosure for protection of construction in progress and completed, from exposure, foul weather, other construction operations and similar activities.

1. Where heat is needed and the permanent building enclosure is not complete, provide temporary enclosures where there is no other provision for containment of heat. Coordinate enclosure with ventilating and material drying or curing requirements to avoid dangerous conditions and effects.

2. Install tarpaulins securely, with incombustible wood framing and other materials. Close openings of 25 square feet or less with plywood or similar materials.

3. Close openings through floor or roof decks and horizontal surfaces with load-bearing wood-framed construction.

N. Project Identification and Temporary Signs: Prepare project identification and other signs of the size indicated; install signs where indicated to inform the public and persons seeking entrance to the Project. Support on posts or framing of preservative treated wood or steel. Do not permit installation of unauthorized signs.

1. Project Identification Signs: Engage an experienced sign painter to apply graphics. Comply with details indicated.

2. Temporary Signs: Prepare signs to provide directional information to construction personnel and visitors.

O. Temporary Exterior Lighting: Install exterior yard and sign lights so that signs are visible when Work is being performed.
P. Collection and Disposal of Waste: Collect waste from construction areas and elsewhere daily. Comply with requirements of NFPA 241 for removal of combustible waste material and debris. Enforce requirements strictly. Do not hold materials more than 7 days during normal weather or 3 days when the temperature is expected to rise above 80 deg F (27 deg C). Handle hazardous, dangerous, or unsanitary waste materials separately from other waste by containerizing properly. Dispose of material in a lawful manner.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Except for use of permanent fire protection as soon as available, do not change over from use of temporary security and protection facilities to permanent facilities until Substantial Completion, or longer as requested by the Architect.


1. Locate fire extinguishers where convenient and effective for their intended purpose, but not less than one extinguisher on each floor at or near each usable stairwell.

2. Store combustible materials in containers in fire-safe locations.

3. Maintain unobstructed access to fire extinguishers, fire hydrants, temporary fire protection facilities, stairways and other access routes for fighting fires. Prohibit smoking in hazardous fire exposure areas.

4. Provide supervision of welding operations, combustion type temporary heating units, and similar sources of fire ignition.

C. Permanent Fire Protection: At the earliest feasible date in each area of the Project, complete installation of the permanent fire protection facility, including connected services, and place into operation and use. Instruct key personnel on use of facilities.
D. Barricades, Warning Signs and Lights: Comply with standards and code requirements for erection of structurally adequate barricades. Paint with appropriate colors, graphics and warning signs to inform personnel and the public of the hazard being protected against. Where appropriate and needed provide lighting, including flashing red or amber lights.

E. Enclosure Fence: When excavation begins, install an enclosure fence with lockable entrance gates. Locate where indicated, or enclose the entire site or the portion determined sufficient to accommodate construction operations. Install in a manner that will prevent people, dogs and other animals from easily entering the site, except by the entrance gates.

1. Provide open-mesh, chain-link fencing with posts set in a compacted mixture of gravel and earth.

F. Security Enclosure and Lockup: Install substantial temporary enclosure of partially completed areas of construction. Provide locking entrances to prevent unauthorized entrance, vandalism, theft and similar violations of security.

1. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

G. Environmental Protection: Provide protection, operate temporary facilities and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

3.5 OPERATION, TERMINATION AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. Limit availability of temporary facilities to essential and intended uses to minimize waste and abuse.
B. Maintenance: Maintain facilities in good operating condition until removal. Protect from damage by freezing temperatures and similar elements.

1. Maintain operation of temporary enclosures, heating, cooling, humidity control, ventilation and similar facilities on a 24-hour day basis where required to achieve indicated results and to avoid possibility of damage.

2. Protection: Prevent water filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

C. Termination and Removal: Unless the Architect requests that it be maintained longer, remove each temporary facility when the need has ended, or when replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with the temporary facility. Repair damaged Work, clean exposed surfaces and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of the Contractor. The Owner reserves the right to take possession of Project identification signs.

2. Remove temporary paving that is not intended for or acceptable for integration into permanent paving. Where the area is intended for landscape development, remove soil and aggregate fill that does not comply with requirements for fill or subsoil in the area. Remove materials contaminated with road oil, asphalt and other petrochemical compounds, and other substances which might impair growth of plant materials or lawns. Repair or replace street paving, curbs and sidewalks at the temporary entrances, as required by the governing authority.

3. At Substantial Completion, clean and renovate permanent facilities that have been used during the construction period, including but not limited to:

   a. Replace air filters and clean inside of ductwork and housings.
b. Replace significantly worn parts and parts that have been subject to unusual operating conditions.

c. Replace lamps that are burned out or noticeably dimmed by substantial hours of use.

END OF SECTION 01500
PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division O, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION:

A. Material and equipment incorporated into the work:

1. Conform to applicable specifications and standards.

2. Comply with size, make, type and quality specified, or as specifically approved in writing by the architect.

3. Manufactured and Fabricated Products:

   a. Design, fabricate and assemble in accord with the best engineering and shop practices.

   b. Manufacture like parts of duplicate units to standard sizes and gages, to be interchangeable.

   c. Two or more items of the same kind shall be identical, by the same manufacturer.

   d. Products shall be suitable for service conditions.

   e. Equipment capacities, sizes and dimensions shown or specified shall be adhered to unless variations are specifically approved in writing.

4. Do not use material or equipment for any purpose other than that for which it is designed or is specified.

1.03 MANUFACTURER'S INSTRUCTIONS:

A. When Contract Documents require that installation of work shall comply with manufacturer's printed instructions, obtain and distribute copies of such, including three copies to Architect.

1. Maintain one set of complete instructions at the job site during installation and until completion.
B. Handle, install, connect, clean, condition and adjust products in strict accord with such instructions and in conformity with specified requirements.

1. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Architect for further instructions.

2. Do not proceed with work without clear instructions.

C. Perform work in accord with manufacturer's instructions. Do not omit preparatory step or installation procedure unless specifically modified or exempted by contract documents.

1.04 TRANSPORTATION AND HANDLING:

A. Arrange deliveries of products in accord with construction schedules, coordinate to avoid conflict with work and conditions at the site.

1. Immediately on delivery, inspect shipments to assure compliance with requirements of contract documents and approved submittals, and that products are properly protected and undamaged.

B. Provide equipment and personnel to handle products by methods to prevent soiling or damage to products or packaging.

1.05 STORAGE AND PROTECTION:

A. Store products in accord with manufacturer's instructions, with seals and labels intact and legible.

1. Store products subject to damage by the elements in weather tight enclosures.

2. Maintain temperature and humidity within the ranges required by manufacturer's instructions.

B. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration.
C. Preparation After Installation:

1. Provide substantial coverings as necessary to protect installed products from damage from traffic and subsequent construction operations. Remove when no longer needed.

1.06 SUBSTITUTIONS AND PRODUCT OPTIONS:

A. Products List:

1. Within (14) days after contract date, submit to Architect a complete list of major products proposed to be used, with the name of the manufacturer and the installing subcontractor. Comply with provisions for Contractor's Options and Substitutions.

B. Contractor's Options:

1. For products specified only by reference standard, select any product meeting that standard.

2. For products specified by naming several products or manufacturers, select any one of the products or manufacturers named, which complies with the specifications.

3. For products specified by naming one or more products or manufacturers and "or equal," Contractor must submit a request as for substitutions for any product or manufacturer not specifically named.

4. For products specified by naming only one product and manufacturer, there is no option.

C. Substitutions:

1. For a period of (14) days after contract date, Architect will consider written requests from Contractor for substitution of products.

2. Submit a separate request for each product, supported with complete data, with drawings and samples as appropriate, including:

   a. Comparison of the qualities of the proposed substitution with that specified.

   b. Changes required in other elements of the work because of the substitution.
c. Effect on the construction schedule.

d. Cost data comparing the proposed substitution with the product specified.

e. Any required license fees or royalties.

f. Availability of maintenance service, and source of replacement materials.

3. Architect shall be the judge of the acceptability of the proposed substitution except where a change in cost is involved.

D. Contractor's Representation:

1. A request for a substitution constitutes a representation that Contractor:

   a. Has investigated the proposed product and determined that it is equal to or superior in all respects to that specified.

   b. Will provide the same warranties or bonds for the substitution as for the product specified.

   c. Will coordinate the installation of an accepted substitution into the work, and meet such other changes as may be required to make the work complete in all respects.

   d. Waives all claims for additional costs, under his responsibility which may subsequently become apparent.

E. Architect will review requests for substitutions with reasonable promptness, and notify Contractor, in writing, of the decision to accept or reject the requested substitution.

PARTS 2 AND 3 PRODUCTS AND EXECUTION

Not applicable.

END OF SECTION 01600
SECTION 01700 - PROJECT CLOSEOUT

PART ONE - GENERAL

1.01 CLEANING

A. Prior to Final Acceptance of the entire work, and at such times as directed by the Owner's Representative, the Contractor shall thoroughly clean all exposed surfaces of the building relating to the Work of the Contract.

B. Prior to such Final Acceptance, all protective coatings shall be removed from finish surfaces, and all glass of the work shall be washed and cleaned.

C. The Contractor shall be held responsible for all damaged materials, which shall be replaced at completion at no cost to the Owner. Glass, tile, hollow metal, stainless steel and aluminum scratched through carelessness or improper cleaning shall be considered damaged and shall be replaced.

1.02 INSTALLATION AND MAINTENANCE INSTRUCTIONS

A. The Contractor shall present to the Owner's Representative three (3) duplicate sets of the manufacturer's installation and maintenance instructions for each and every item furnished or erected.

B. In each of these, the correct model number and the data for the model number shall be checked off in ink where the literature covers more than one model number.

1.03 ADJUSTMENTS

A. The complete installation consisting of the several parts and systems and all equipment installed according to the requirements of the Specifications and as shown on the Drawings shall be adjusted as required and ready in all respects for use by the Owner at the time of Final Acceptance of the Work.
SECTION 01800 - GUARANTEE - WARRANTY

PART ONE - GENERAL

1.01 GUARANTEE PERIOD

A. The General Contractor shall and hereby does guarantee and warrant that all work for this building, under this Contract, shall be free from defects or faulty labor and/or materials for a period of two (2) years from the date of Final Acceptance of same, except when longer periods are herein specified, which develop within any guarantee periods.

1.02 FINAL PAYMENT

A. Final payment is contingent upon the Owner's Representative's receipt of such guarantees and/or warranties from the General Contractor.

END OF SECTION 01800
SOILS INVESTIGATION
41A DISTRICT COURT BUILDING
JACK MILLER BOULEVARD AND VAN DYKE ROAD
SHELBY TOWNSHIP, MICHIGAN

FAZEL KHAN AND ASSOCIATES, INC.
43279 SCHOENHERR ROAD
STERLING HEIGHTS, MICHIGAN 48313

APRIL 12, 2017
BY
McDOWELL & ASSOCIATES
April 12, 2017

Fazal Khan and Associates, Inc.
43279 Schoenherr Road
Sterling Heights, Michigan 48313

Job No. 17-099

Attention: Ms. Carol Thurber

Subject: Soils Investigation

41A District Court Building
Jack Miller Boulevard and Van Dyke Road
Shelby Township, Michigan

Dear Ms. Thurber:

In accordance with your request, we have performed a Soils Investigation at the subject project.

Four (4) Soil Test Borings, designated 1 through 4, were performed at the locations staked by your surveyors. The approximate locations of the borings are shown on the Soil Boring Location Plan which accompanies this report. Borings 2 and 3 were drilled in the planned building area and were advanced to a depth of about twenty feet (20’) below the existing ground surface at these boring locations. Borings 1 and 4 were drilled in planned pavement areas and were advanced to a depth of five feet six inches (5’6’’). Surface elevations shown on the boring logs were provided by your surveyors.

Soil descriptions, groundwater observations and the results of field and laboratory tests are to be found on the accompanying Logs of Soil Test Borings and summary sheet of Sieve Analysis results.

Borings 1 and 4 encountered nine inches (9’’’) and one foot three inches (1’3’’’) of topsoil and fill soils, followed by compact brown sand to gravelly sand which were found throughout the remainder of these borings. Borings 2 and 3 encountered nine inches (9’’’) and one foot (1’) of topsoil and fill soils, eight feet six inches (8’6’’’) and twelve feet three inches (12’3’’’) of compact brown fine sand to sand followed by extremely compact brown to gray silt to silty sand and extremely stiff blue silty clay. Fill soils were found at Borings 1 and 2 and consist of brown and discolored brown sand.

Soil descriptions and depths shown on the boring logs are approximate indications of change from one soil type to another and are not intended to represent an area of exact geological change or stratification. Also, the site shows signs of modification which could indicate fill and soil conditions different from those encountered at the boring locations.
Water was encountered in Borings 2 and 3 at depths of five feet (5') and seven feet (7') below the existing ground surface. Water was measured upon completion of the drilling operation in Boring 3 at a depth of seven feet (7'). Boring 2 was found to cave in upon completion at a depth of four feet (4'). No water was encountered in Borings 1 and 4. It should be noted that short-term groundwater observations may not provide a reliable indication of the depth of the water table. Water levels in granular soils fluctuate with seasonal and climatic changes as well as the amount of rainfall in the area immediately prior to the measurements.

Standard Penetration Tests made during sampling indicate that the native soils at the site have fair to very good strengths and densities. Tests taken at a depth of two feet six inches (2'6") gave results of eleven (11) and thirteen (13) blows per foot. The five-foot (5') test values varied from eight (8) to eighteen (18) blows per foot. At a depth of seven feet six inches (7'6"), the results were seven (7) and eight (8) blows per foot. At ten feet (10') and below, penetration indices varied from fourteen (14) blows per foot to thirty-six (36) blows per six inches (6").

It is understood that a two-story slab-on-grade building is planned to be constructed at the site. It is assumed that the structure will transmit moderate loads to the supporting soils. New pavement areas are planned to service the new building. We have assumed that these pavements will support mostly automobile traffic with occasional trucks.

Based on the project information provided and the results of field and laboratory tests, it is believed that the new structure could be supported by conventional spread or strip footings. All exterior footings should be constructed at, or below, a minimum frost penetration depth of three feet six inches (3'6") below finished grade. All interior and exterior load-bearing footings should extend through non-engineered fill soils, soils containing a significant amount of organic substances, or excessively weak soils. All strip footings should be continuously reinforced in order to minimize the noticeable effects of differential settlement.

Footings constructed at the following boring locations could be proportioned for the design soil pressures listed in the table below:

<table>
<thead>
<tr>
<th>Boring</th>
<th>Depth</th>
<th>Soil Pressure (psf)</th>
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</thead>
<tbody>
<tr>
<td>2</td>
<td>1'6&quot; to 3'6&quot;</td>
<td>3000</td>
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<tr>
<td></td>
<td>4'0&quot; to 9'6&quot;</td>
<td>2500</td>
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<tr>
<td></td>
<td>10'0&quot; to 12'0&quot;</td>
<td>4000</td>
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<tr>
<td>3</td>
<td>1'6&quot; to 2'6&quot;</td>
<td>3000</td>
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<tr>
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<td>3'0&quot; to 5'6&quot;</td>
<td>2500</td>
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<td>6'0&quot; to 8'0&quot;</td>
<td>2000</td>
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<tr>
<td></td>
<td>8'6&quot; to 12'0&quot;</td>
<td>4000</td>
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</tbody>
</table>

Based on the soils encountered in the borings, it appears the site soils can be classified according to the International Building Code as Class D Seismic Classification with a ground acceleration of about five percent (5%).
Fill soils were found at Borings 3 and 4. If the possibility of more than normal differential movement can be tolerated, slab-on-grade floors or floor-supporting backfill could be placed at, or near, the present grade. If any existing asphalt or concrete pavement is found within the proposed building area, it should be either removed or thoroughly broken. If any existing underground utilities are found within the planned building area, they should be removed and properly backfilled or grouted in place. Any topsoil, soft, loose, highly organic or obviously objectionable material should be removed and the subgrade thoroughly proof-compactled with heavy, rubber-tired equipment. If, during the proof-compaction operation, areas are found where the soil yields excessively, the yielding materials should be scarifled, dried and re-compactled or removed and replaced with engineered fill. Where fill or backfill is required to raise the subgrade for concrete floors, it is suggested that clean, well-graded granular soils be used. If clay material is utilized, it should be placed within two percent (2%) of its optimum moisture content. The fill should be deposited in horizontal lifts not to exceed nine inches (9") in thickness with each lift being compacted uniformly to a minimum density of ninety-five percent (95%) of its maximum value as determined by the Modified Proctor Test (AASHTO T-180 or ASTM D-1557).

If the possibility of more than normal differential movement cannot be tolerated, then all existing fill soils should be removed and replaced with engineered fill meeting the requirements outlined above or the floor slab should be structurally supported.

It appears that the subgrade soils consist of sand soils. We would expect the sand soils to have California Bearing Ratios (CBRs) on the order of nine percent (9%) and a modulus of subgrade reaction of about two hundred pounds per cubic inch (200 pci). It appears these soils may have a low percentage of silt-size particles which would indicate they would tend to have a slight frost heave potential.

Based on the above estimated CBR value, we have made the following pavement analysis. The site soils appear to be slightly susceptible to frost heave. Consequently, it is suggested that in areas of automobile and light truck traffic, three inches (3") of asphalt with six inches (6") of high quality, well-graded granular base course be used. In the areas subject to a considerable amount of truck traffic, it is recommended that the asphalt thickness be increased by a minimum of one and one-half inches (1½"). In the areas to be paved, the site should be prepared in a manner similar to that recommended above. In addition, the subgrade should be reworked until approximately the upper one foot (1') of the subgrade is compacted to at least ninety-five percent (95%) of its maximum dry density as determined by the Modified Proctor Test. It is recommended as a minimum that stub drains be provided at the storm sewer catch basins to provide some drainage for the pavement base. The subgrade should be properly sloped to allow drainage of surface water. Eight inches (8") of concrete pavement should be used in the dumpster area and other intensive truck wheel load areas.

Experience indicates that the actual subsoil conditions at the site could vary from those found at the soil borings made at specific locations. It is, therefore, essential that McDowell & Associates be notified of any variation of soil conditions to determine their effects on the recommendations presented in this report. The evaluations and recommendations presented in this report have been formulated on the basis of reported or assumed data relating to the proposed project. Any
significant change in this data in the final design plans should be brought to our attention for
review and evaluation with respect to the prevailing subsoil conditions.

It is recommended that the services of McDowell & Associates be engaged to observe the soils
in the footing excavations prior to concreting in order to test the soils for the required bearing
capacities. Testing should also be performed to check that suitable materials are being used for
controlled fills and that they are properly placed and compacted.

If we can be of any further service, please feel free to call.

Very truly yours,

McDOWELL & ASSOCIATES

Daniel A. Kaniarz, M.S., P.E.

DAK/ks
<table>
<thead>
<tr>
<th>Sample &amp; Type</th>
<th>Depth</th>
<th>Legend</th>
<th>SOIL DESCRIPTION</th>
<th>Penetration Type</th>
<th>Moisture %</th>
<th>Natural Wt. P.C.F.</th>
<th>Dry Den. Wt. P.C.F.</th>
<th>Unc. Comp.</th>
<th>Sr. %</th>
<th>Remarks</th>
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<td>0'6&quot; Moist dark brown sandy TOPSOIL with Vegetation and occasional stones, fill</td>
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<td>1'3&quot; Moist discolored brown SAND with topsoil, fill</td>
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**TYPE OF SAMPLE**
- D - DISTURBED
- U.L. - UNDISTURBED LINEER
- S.T. - SHELBY TUBE
- S.S. - SPLIT SPOON
- R.C. - ROCK CORE
- P - PENETROMETER

**REMARKS:**
Standard Penetration Test - Driving 2" OD Sampler 1 With 140# Hammer Falling 30". Count Made at 6" Intervals

**GROUND WATER OBSERVATIONS**
- G.W. ENCOUNTERED AT FT INS.
- G.W. AFTER COMPLETION FT INS.
**LOG OF SOIL**

**BORING NO.** 2

**PROJECT** Soils Investigation - 41A District Court Building

**LOCATION** Jack Miller Boulevard and Van Dyke Road

Shelby Township, Michigan

<table>
<thead>
<tr>
<th>Sample &amp; Type</th>
<th>Depth</th>
<th>SOIL DESCRIPTION</th>
<th>Penetration Bore for 6&quot;</th>
<th>Moisture %</th>
<th>Natural Wt. P.C.F.</th>
<th>Dry/Den Wt. P.C.F.</th>
<th>Conc. Comp. Strength P.C.F.</th>
<th>Str. %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>0'</td>
<td>Moist dark brown sandy TOPSOIL with vegetation, fill</td>
<td>4</td>
<td>6.3</td>
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<tr>
<td>A</td>
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<td>1 0'</td>
<td>Moist brown and discolored SAND with some topsoil, fill</td>
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<td>Compact wet brown fine SAND with trace of silt</td>
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</table>

**TYPE OF SAMPLE**
- D. - DISTURBED
- U.L. - UNDISTURBED LINER
- S.T. - SHELF TUBE
- S.S. - SPIRIT SPOON
- A.C. - ROCK CORE
- ( ) - PENETROMETER

**REMARKS:**

**GROUND WATER OBSERVATIONS**

- G.W. ENCOUNTERED AT 5 FT 0 INS.
- G.W. ENCOUNTERED AT 4 FT 0 INS.
- G.W. AFTER COMPLETION 4 FT 0 INS.
- G.W. VOLUMES

Standard Penetration Test - Driving 2" OD Sampler 1 With 1400# Hammer Falling 35°. Count Made at 6" Intervals

Heavy Cave-in at 40'
### Log of Soil Boring No. 3

**Project:** Soils Investigation - 41A District Court Building

**Location:** Jack Miller Boulevard and Van Dyke Road

**Shelby Township, Michigan**

<table>
<thead>
<tr>
<th>Sample Type</th>
<th>Depth</th>
<th>Soil Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>2</td>
<td>Moist dark brown sandy TOPSOIL with vegetation</td>
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<td>SS</td>
<td>3</td>
<td>Compact moist brown fine to medium SAND with trace of silt</td>
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<tr>
<td>B</td>
<td>4</td>
<td>Compact moist brown fine SAND with trace of silt</td>
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<tr>
<td>SS</td>
<td>5</td>
<td>Compact moist brown fine SAND with trace of silt</td>
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<td>C</td>
<td>7</td>
<td>Compact wet brown fine to medium SAND with trace of silt</td>
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<tr>
<td>SS</td>
<td>8</td>
<td>Extremely compact wet brown silty fine to medium SAND</td>
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<tr>
<td>D</td>
<td>10</td>
<td>Extremely compact wet brown silty fine to medium SAND</td>
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<tr>
<td>SS</td>
<td>15</td>
<td>Extremely stiff moist blue silty CLAY</td>
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<tr>
<td>F</td>
<td>19</td>
<td>Extremely compact wet gray silty fine SAND with trace of clay and wet gray silt seams</td>
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</tbody>
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**Remarks:**

- Standard Penetration Test: Driving 2" OD Sampler 1' With 100 lb. Hammer Falling 30°; Count Made at 6" Intervals

**Ground Water Observations:**

- G.W. Encountered at 7 ft. 0 ins.
- G.W. After Completion 7 ft. 0 ins.
- G.W. Volumes Heavy
<table>
<thead>
<tr>
<th>Sample &amp; Type</th>
<th>Depth</th>
<th>Legend</th>
<th>SOIL DESCRIPTION</th>
<th>Penetration Blows for 1'</th>
<th>Moisture %</th>
<th>Natural WA P.C.F.</th>
<th>Dry Gain WA P.C.F.</th>
<th>Unit Comp. Strength PSF</th>
<th>Str. %</th>
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<td>1</td>
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<tr>
<td>SS</td>
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<td>Compact moist brown gravelly SAND with trace of silt and sand seams</td>
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<td>6.4</td>
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<td>3'5&quot;</td>
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**TYPE OF SAMPLE**
- D - DISTURBED
- U.L. - UNDISTURBED LINER
- S.T. - SHIELDED TUBE
- S.S. - SPLIT SPOON
- R.C. - ROCK CORE
- ( ) - PENETROMETER

**REMARKS:**
Standard Penetration Test - Driving 2" OD Sampler 1 With 140# Hammer Falling 30". Count Made at 6" Intervals

**GROUND WATER OBSERVATIONS**
- G.W. ENCOUNTERED AT 10 FT. INS.
- G.W. ENCOUNTERED AT 15 FT. INS.
- G.W. AFTER COMPLETION 10 FT. INS.
- G.W. AFTER 10 FT. INS.
- G.W. VOLUMES None

**PROJECT**
Soil Investigation - 41A District Court Building

**LOCATION**
Jack Miller Boulevard and Van Dyke Road

**SHEBY TOWNSHIP, MICHIGAN**

**SURFACE ELEV.** 679.5

**DATE** 4-4-17

**JOB NO.** 17-099

**BORING NO.** 4
### SIEVE ANALYSIS

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SECTION 02230 - SITE CLEARING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Protecting existing trees and vegetation to remain.
2. Removing trees and other vegetation.
3. Clearing and grubbing.
4. Topsoil stripping.
5. Removing above-grade site improvements.

B. Related Sections include the following:
1. Section 02300 "Earthwork" for soil materials, excavating, backfilling, and site grading.
2. Section 02480 "Landscape Work" for finish grading, including placing and preparing topsoil for lawns and planting
3. Section 02530 “Sanitary Sewerage.”
4. Section 02630 “Storm Drainage.”
5. Section 02751 “Concrete Pavement”

1.3 DEFINITIONS

A. Topsoil: Natural or cultivated surface-soil layer containing organic matter and sand, silt, and clay particles; friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of weeds, roots, and other deleterious materials.
1.4 MATERIALS OWNERSHIP

A. Except for materials indicated to be stockpiled or to remain Owner's property, cleared materials shall become Contractor's property and shall be removed from the site.

1.5 SUBMITTALS

A. Photographs, DVD or videotape, sufficiently detailed, of existing conditions of trees and plantings, adjoining construction, and site improvements that might be misconstrued as damage caused by site clearing.

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct roads, walks, or other adjacent occupied or used facilities without permission from Owner.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. Satisfactory Soil Materials: Requirements for satisfactory soil materials are specified in Section 02300 "Earthwork."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Provide erosion-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
C. Locate and clearly flag trees and vegetation to remain.

D. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TREE PROTECTION

A. Erect and maintain a temporary fence around drip line of individual trees or around perimeter drip line of groups of trees to remain. Remove fence when construction is complete.
   1. Do not store construction materials, debris, or excavated material within drip line of remaining trees.
   2. Do not permit vehicles, equipment, or foot traffic within drip line of remaining trees.

B. Do not excavate within drip line of trees, unless otherwise indicated.

C. Repair or replace trees and vegetation indicated to remain that are damaged by construction operations, in a manner approved by Architect.

3.3 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, grass, and other vegetation to permit installation of new construction. Removal includes digging out stumps and obstructions and grubbing roots.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain.
   2. Cut minor roots and branches of trees indicated to remain in a clean and careful manner where such roots and branches obstruct installation of new construction.
3. Completely remove stumps, roots, obstructions, and debris extending to a depth of 18 inches below exposed Subgrade, unless noted otherwise.

4. Use only hand methods for grubbing within drip line of remaining trees.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material, unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding 8-inch loose depth, and compact each layer to a density equal to adjacent original ground.

3.4 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to whatever depths are encountered in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Strip surface soil of unsuitable topsoil, including trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil materials away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust.
   1. Do not stockpile topsoil within drip line of remaining trees.

3.5 DISPOSAL

A. Disposal: Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials, including trash and debris, and legally dispose of them off Owner’s property.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
1. Preparing subgrades for slabs-on-grade, walks, pavements, lawns, and plantings.
2. Excavating and backfilling for buildings and structures.
3. Proof-rolling subgrade.
4. Granular fill course for slabs-on-grade.
5. Base course for concrete walks and pavements.
6. Excavating and backfilling trenches within building lines.
7. Excavating and backfilling trenches for buried mechanical and electrical utilities and pits for buried utility structures is work of Divisions 15 and 16. This section sets forth the requirements of such work.

B. Related Sections include the following:
1. Section 02230 "Site Clearing" for site stripping, grubbing, removing topsoil, and protecting trees to remain.
2. Section 02480 “Landscape Work”
3. Section 02530 “Sanitary Sewerage.”
4. Section 02630 “Storm Drainage.”
5. Section 02751 “Concrete Pavement.”
6. Division 15 and 16 Sections for excavating and backfilling buried mechanical and electrical utilities and buried utility structures.

1.3 DEFINITIONS

A. Backfill: Soil materials used to fill an excavation.
1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Layer placed between the subgrade and asphalt or concrete paving.

C. Bedding Course: Layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

E. Compacted: Material at the required compaction or higher.

F. Excavation: Removal of material encountered above subgrade elevations.
   1. Additional Excavation: Excavation below subgrade elevations as directed by Architect. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.
   2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Maximum Density: The dry density at optimum moisture content in accordance with ASTM D1557 (Modified Proctor).

I. Required Compaction: The ratio of in-place density to maximum density, expressed as a percentage.

J. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.
K. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

L. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
   1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
   2. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill.

1.5 QUALITY ASSURANCE

A. Codes and Standards: Perform earthwork complying with requirements of authorities having jurisdiction.

B. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented according to ASTM D 3740 and ASTM E 548.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated:
1. Notify the General Contractor and Owner not less than 72 hours in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without the General Contractor and Owner’s written permission.
3. Contact MISS DIG before excavating.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: ASTM D 2487 soil classification groups GW, GP, GM, SW, SP, and SM, or a combination of these group symbols; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: ASTM D 2487 soil classification groups GC, SC, ML, MH, CL, CH, OL, OH, and PT, or a combination of these group symbols.
   1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Backfill and Fill: Satisfactory soil materials.

E. Base: Naturally or artificially graded mixture of natural or crushed gravel or crushed stone complying with MDOT Table 902-1 21AA Dense Graded Aggregate.

F. Engineered Fill: Granular soil material complying with MDOT Table 902-1, Class II Granular Material.

G. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.
H. Granular Fill: Granular soil material complying with MDOT Table 902-1, Class II Granular Material.

I. Pea Gravel: Clean, hard, durable, free flowing, naturally rounded particles of rock, free from clay lumps, with 100% passing a 3/8” sieve and not over 5% passing a #8 sieve.

2.2 ACCESSORIES

A. Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility; colored as follows:

B. Detectable Warning Tape: Acid- and alkali-resistant polyethylene film warning tape manufactured for marking and identifying underground utilities, minimum 6 inches wide and 4 mils thick, continuously inscribed with a description of utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:
2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

C. Drainage Fabric: Nonwoven geotextile, specifically manufactured as a drainage geotextile; made from polyolefins, polyesters, or polyamides; and with the following minimum properties determined according to ASTM D 4759 and referenced standard test methods:
1. Grab Tensile Strength: 110 lbf; ASTM D 4632.
2. Tear Strength: 40 lbf; ASTM D 4533.
5. Apparent Opening Size: No. 50; ASTM D 4751.
3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

D. Subgrade is prone to disturbance during construction operations. Subgrade soils may also become disturbed due to ponding water and channeled construction traffic. Disturbed subgrade soils must be properly improved prior to floor slab and pavement construction or placement of engineered fill.

3.2 PROOF-ROLLING

A. After stripping of topsoil and other surface organic matter and deleterious material and before further excavation, proof-roll entire building pad area to locate overly loose or soft areas and to compact the surface.

1. Subgrade resulting from topsoil and organic material removal shall be thoroughly proof-rolled with fully loaded tandem-axle dump truck or other suitable piece of pneumatic-tired construction equipment. Proof-roll a minimum of ten passes in each of perpendicular direction.
B. Areas of unsuitable subgrade shall be dried and recompacted in-place or remove and replaced with engineered fill.

C. Special care shall be exercised when proofrolling adjacent to the existing building to minimize disturbance to existing footings and floor slabs.
   1. Use light proofrolling equipment for a strip approximately ten (10) feet wide along the existing building.

D. Prior to concrete slab placement the prepared subgrade shall again be thoroughly proof-rolled. Disturbed areas shall be recompacted or removed and replaced with engineered fill.

E. Proof-rolling operations must be done in presence of the Testing Agency.

3.3 DEWATERING

A. Subgrade soils are prone to disturbance due to ponded water.

B. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

C. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
   2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.4 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavation to subgrade elevations regardless of the character of surface and
subsurface conditions encountered, including rock, soil materials, and obstructions.
1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.
   2. Excavation for Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended for bearing surface.

3.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated cross sections, elevations, and grades.

3.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.
   1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide a working clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit, unless otherwise indicated.
   1. Clearance: As indicated.
C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.

3.8 EXCAVATION FOR SWALES

A. Excavate swales to indicated gradients, lines, depths and elevations.

1. Side slope of swales not to exceed 6:1.

3.9 APPROVAL OF SUBGRADE

A. Notify Architect when excavations have reached required subgrade.

B. If Architect determines based on the Testing Agency’s recommendation that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

C. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect.

3.10 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill may be used when approved by Architect.

1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.11 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile soil materials without intermixing.
Place, grade, and shape stockpiles to drain surface water.
Cover to prevent windblown dust.
1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.12 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including but not limited to perimeter insulation.
   2. Surveying locations of underground utilities for record documents.
   3. Inspecting and testing underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Removing temporary shoring and bracing, and sheeting.

3.13 UTILITY TRENCH BACKFILL

A. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

B. Backfill trenches excavated under footings and within 18 inches of bottom of footings; fill with concrete to elevation of bottom of footings.

C. Place and compact initial backfill of base course material, free of particles larger than 1 inch, to a height of 12 inches over the utility pipe or conduit.
   1. Carefully compact material under pipe haunches and bring backfill evenly up on both sides and along the full length of utility piping or conduit to avoid damage or displacement of utility system.

D. Coordinate backfilling with utilities testing.

E. Fill voids with approved backfill materials while shoring and bracing, and as sheeting is removed.
F. Place and compact final backfill of satisfactory soil material to final subgrade.

G. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.14 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, and deleterious materials from ground surface before placing fills.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

C. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use granular fill or approved engineered fill as indicated on drawings.
   3. Under steps and ramps, use approved engineered fill.
   4. Under building slabs, use approved engineered fill.
   5. Under footings and foundations, use approved engineered fill.

3.15 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air-dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.16 COMPACTION OF BACKFILLS AND FILLS
A. Place backfill and fill materials in layers not more than 8 inches in loose depth for material compacted by heavy compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
   1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material at 95 percent.
   2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 92 percent.
   3. Under lawn or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill material at 85 percent.

3.17 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. In general, the areas within the limits of buildings shall be rough graded to elevations 4” below bottom of slabs, filled with granular material as specified and finish graded to elevations at bottom of slabs.
   2. Provide a smooth transition between adjacent existing grades and new grades.
   3. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:
   1. Lawn or Unpaved Areas: Plus or minus 1 inch.

EARTHWORK 02300-12
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.18 BASE COURSES

A. Under pavements and walks, place base course on prepared subgrade and as follows:
   1. Compact base courses at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.
   2. Shape base to required crown elevations and cross-slope grades.
   3. When thickness of compacted base course is 6 inches or less, place materials in a single layer.
   4. When thickness of compacted base course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.19 GRANULAR FILL COURSE

A. Under slabs-on-grade, place granular fill course on prepared subgrade and as follows:
   1. Compact granular fill course to required cross sections and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
   2. When compacted thickness of drainage course is 6 inches or less, place materials in a single layer.
   3. When compacted thickness of drainage course exceeds 6 inches, place materials in equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.20 AGGREGATE FILL COURSE
A. In areas below concrete or hot-mix asphalt pavements, place 21AA crushed limestone aggregate fill course on prepared subgrade and as follows:

1. Compact aggregate fill course to required thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.
2. Place materials equal layers, with no layer more than 6 inches thick or less than 3 inches thick when compacted.

3.21 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At strip footing subgrades, at least one test each 10 feet o.c of each soil stratum will be performed to verify design bearing capacities.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 1000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 25 feet or less of wall length, but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 50 feet or less of trench length, but no fewer than two tests.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction
specified, scarify and moisten or aerate, or remove and replace soil to depth required; recompact and retest until specified compaction is obtained.

3.22 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.
   1. Scarify or remove and replace soil material to depth as directed by Architect; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfaced, backfill with additional soil material, compact, and reconstruct surfacing.
   1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to the greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION 02300
PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Sedimentation Control Fencing
B. Catch Basin / Inlet Protection
C. Temporary and Permanent Sedimentation Control Measures

1.2 REGULATORY REQUIREMENTS

A. Work under this Section includes all work necessary for effective soil erosion and sedimentation control in conformance with Part 91, Act 451, PA 1994, the Soil Erosion and Sedimentation Control Act.

B. Rules, regulations or laws of any controlling governmental agency shall govern, when they are more stringent than the requirements of this Section.

C. All earth changes shall be made in such a manner as to minimize the area of disturbed land exposed and unprotected against erosion and the duration of such exposure.

D. Sediment caused by accelerated soil erosion shall be restricted to a non-polluting minimum (as determined by the agency designated in accordance with, and having jurisdiction and responsibility for the enforcement of sedimentation control).

E. All sedimentation control measures shall be maintained in an operating condition satisfactory to the designated agency, for the period of time, which that agency deems necessary. This provision applies to all facilities that directly receive waters from the earth-change area, whether such facilities are a part of the proposed construction or existed prior to proposed construction.

F. Temporary stabilization measures shall be repeated when, and as often as, required by the aforementioned agency.
G. Any facility constructed for the conveyance of water around, through or from the earth-change area shall limit the water flow to a non-erosive velocity.

H. Temporary sedimentation control devices and facilities shall be removed upon completion of the primary construction. The land surface area formerly occupied by such facilities shall then be graded and restored in accordance with the Plans and Specifications.

1.3 PERMITS

A. Obtain all pertinent permits including a Soil Erosion Control Permit from the MDEQ, county or local governing agency having jurisdiction of the Erosion Control.

B. Submit an NPDES Notice of Coverage, if required, when the soil erosion permit is received.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Straw bales and mulch shall be clean wheat straw or marsh hay. Straw shall be clean and free of weeds and weed seed. Hay will be allowed only when straw is not available. Bales are to be standard rectangular shape held together with 2 strands of hemp rope.

B. Sediment control / silt fence shall be a geotextile filter fabric capable of containing sediment, attached to wooden stakes capable of supporting the geotextile fabric.

C. Acceptable geotextile catch basin filter wrap

PART 3 - EXECUTION

3.1 CONSTRUCTION SEQUENCE

A. To minimize the area of unstabilized land surface over which storm waters must flow, construction shall proceed from lower ground toward higher ground whenever possible.
3.2 TEMPORARY STOCKPILES

A. The Site Contractor shall take steps to prevent, or contain on-site, erosion from material stockpiles.

3.3 SEDIMENTATION CONTROL

A. The Site Contractor shall provide a suitable temporary sedimentation control facility at any connection to an existing enclosed storm drain, to minimize deposition of sediment in the existing storm drain during construction.

B. To prevent sediment from entering existing storm drains during the construction period, the Site Contractor shall provide suitable control facilities around storm water inlet facilities.

C. All open ditches and natural watercourses intercepted by the proposed construction shall be temporarily re-routed, provided with temporary sedimentation control facilities within their cross-section, and/or diverted into a newly-established drain via non-erosive channels.

D. Temporary sedimentation control devices and/or facilities shall be as designated on the Plans. Modifications to the Plan requires prior approval of the Engineer and local permitting agency.

E. In all cases, such facilities, whether permanent or temporary, shall be provided prior to any significant clearing, grading or surface disruption of the tributary area.

3.4 DE-WATERING

A. Pumped water from well points or de-watering wells installed to lower the water table to facilitate the proposed construction shall not discharge onto unstabilized areas. Such discharge shall be conveyed by pipe, hose or stabilized channel to a settling basin or other suitable sedimentation control facility.
3.5 WATERCOURSE PROXIMITY

A. Where natural streams, marshes or existing drainage watercourses are encountered within, or are situated within 500' of the proposed construction, special care shall be exercised to minimize erosive losses and water contamination. These shall include, but not be limited to, the following:

1. Prompt completion of Work (including clean-up operations) in all areas adjacent to streams, marshes or watercourses.
2. Use of temporary or permanent erosion control devices during construction to minimize erosion and the resultant deposition of sediment into any stream, marsh or watercourse.

3.6 VEHICULAR CONTROLS

A. Where vehicles or heavy equipment must cross streams, ditches or other existing watercourses, installation of culverts or bridges at approved locations will generally be required. Where frequent use of improved roads by off-the-road vehicles is encountered, suitable cleaning methods shall be used to minimize the transfer of sediment-producing materials from the wheels of the vehicles onto the improved surface. Site Contractor shall keep adjacent roads free of debris.

3.7 RESTABILIZATION OF TERRAIN

A. Final cleanup shall leave the property in equal or better condition than it was at the beginning of construction. Cleanup operations including at least rough grading and temporary stabilization shall be started as soon as feasibly possible where:

1. Pipe is laid in any location
2. One acre or more of the ground surface is brought to its approximate proposed elevation, in an earth excavation, mining, landfilling, mass grading, or land balancing project.
3. Substantial completion of the base, the curb, or the curb and gutter, whichever first occurs, in a road, street, highway, parking area or sidewalk construction project; and shall be completed within the next fifteen (15) days.

B. Temporary stabilization applied during freezing weather shall consist of hay or straw mulch applied at the rate of 2 tons per acre, "tacked" in place by locally approved methods. Temporary stabilization applied during other than freezing weather shall consist of perennial rye grass applied at the rate of 25 pounds per acre with hay or straw mulch applied at the rate of 2 tons per acre, "tacked" in place with locally approved methods.

C. Temporary stabilization shall be provided during the non-growing season for all areas to be seeded / sodded. This time period is generally from October 15 through April 15, both inclusive.

D. Temporary stabilization shall be provided for all uncompleted areas where significant earth disruption ceases for more than 30 days.

E. All areas which have been temporarily stabilized shall be permanently stabilized no later than 30 days following commencement of the planting season immediately following substantial completion of construction.

F. All mulch used for temporary stabilization shall be removed prior to permanent stabilization.

G. Permanent Stabilization is hereby defined as the Work described elsewhere in the Specifications under Section 02480 "Landscape Work".

3.8 SITE CONTRACTOR'S GENERAL RESPONSIBILITY

A. The Site Contractor shall be responsible for the proper implementation of the "Soil Erosion and Sedimentation Control Plan" as a part of this Contract, unless noted otherwise. If a Soil Erosion and Sedimentation Control plan is supplied in the project drawings, the Site Contractor shall install the proposed Soil Erosion and Sedimentation Control measures per the plan. If a plan is not supplied, it is the responsibility of the Site Contractor...
Contractor to meet all local and state ordinances. A regular inspection program and a thorough maintenance program shall be developed and implemented by the Contractor to insure the effectiveness of the erosion and sedimentation control practices.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 DESCRIPTION OF WORK:

A. The extent of foundation drainage system work is shown on the drawings.

B. Related Work Specified Elsewhere:


2. Drainage fill course under slabs on grade: Section 02620.

1.3 QUALITY ASSURANCE:

A. Codes and Standards:

1. Perform foundation drainage work in compliance with applicable requirements of governing authorities having jurisdiction.

1.4 SUBMITTALS:

A. Certification:

1. Submit two (2) copies of Certification signed by the foundation drainage system installer that installed materials conform to specified requirements and system was successfully checked and tested prior to covering with filtering and drainage fill.

PART 2 - PRODUCTS

2.01 DRAINAGE PIPE AND FITTINGS:

A. Furnish drainage pipe complete with bends, reducers, adapters, couplings, collars and joint materials.

2.02 SOIL MATERIALS:

A. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense composite.

B. Drainage Fill: Uniformly graded mixture of natural or crushed gravel, crushed stone, and natural sand with 100% passing a 1-1/2” sieve and 0-5% passing a No. 50 sieve.

C. Filtering Material: Uniformly graded mixture of natural or crushed gravel, crushed stone, and natural sand, with 100% passing a ½” sieve and 0-5% passing a No. 50 sieve.

PART 3 – EXECUTION

3.01 INSPECTION:

A. Examine the areas and conditions under which foundation drainage system is to be installed and notify the General Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in an acceptable manner.

3.02 INSTALLATION:

A. Impervious Fill:

1. Place impervious fill material on the subgrade under drainage system. Place and compact impervious fill 6” deep and 12” wide.

B. Filtering Material:

1. Place a supporting layer of filtering material over compacted subgrade where drainage pipe is to be laid to a compacted depth of not less than 4”.

2. After testing of drain lines, place additional filtering material to a 4” depth around sides and top of drains.

C. Laying Drain Pipe:

1. Lay drain pipe solidly bedded in filtering material. Provide full bearing for each pipe section throughout its length, to true grades and alignment, and continuous slope in the direction of flow.
D. Testing Drain Lines:

1. Test or check lines before backfilling to assure free flow. Remove obstructions, replace damaged components and retest system until satisfactory.

E. Drainage Fill:

1. Place drainage fill over drain lines after satisfactory testing and covering of drain lines with filtering material. Completely cover drain lines to a width of at least 6” on each side and 12” above top of pipe, unless more coverage is indicated on the drawings. Place fill material in layers not exceeding 3” in loose depth and compact each layer placed.

   a. Overlay drainage fill material with one layer of 15-lb. asphalt or tar-saturated felt overlapping edges at least 4”.

END OF SECTION 02411
PART 1 - GENERAL

1.01 RELATED DOCUMENTS:
A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:
A. The extent of the landscape development work is shown on the drawings and in schedules.
B. Sub-grade Elevations: Elevation, filling and grading required to establish elevations shown on the drawings are not specified in this Section. Refer to Section 02300, Earthwork.

1.03 QUALITY ASSURANCE:
A. Subcontract the landscape work to a single firm specializing in landscape work.
B. Source Quality Control:
1. General: Ship landscape materials with certificates of inspection as required by governmental authorities. Comply with governing regulations applicable to landscape materials.
2. Do not make substitutions. If specified landscape material is not obtainable, submit to Architect proof of non-availability and proposal for use of equivalent material. When authorized, adjustment of contract amount will be made.
3. Analysis and Standards: Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agricultural Chemists, wherever applicable or as further specified.
4. Trees: Provide trees grown in a recognized nursery in accordance with good horticultural practice. Provide healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, or disfigurement.
a. Sizes: Provide trees of the sizes shown or specified. Trees of larger size may be used if acceptable to the Architect, and if sizes of roots or balls are increased proportionately.

5. Inspection: Architect reserves the right to inspect trees either at place of growth, or at site before planting for compliance with requirements for names, variety, size, and quality.

1.04 SUBMITTALS:

A. Certification:

1. Submit two (2) copies of certificates of inspection as required by governmental authorities, and manufacturer's or vendors certified analysis for soil amendments and fertilizer materials. Submit other data substantiating that materials comply with specified requirements.

B. Planting Schedule:

1. Submit three (3) copies of planting schedule showing scheduled dates for each type of planting in each area of site.

C. Maintenance Instructions:

1. Submit two (2) copies of typewritten instructions recommending procedures to be established by the Owner for the maintenance of landscape work for one (1) full year. Submit prior to expiration of required maintenance period(s).

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Packaged Materials:

1. Deliver packaged materials in containers showing weight, analysis and name of manufacturer. Protect materials from deterioration during delivery and while stored at the site.

B. Plant Materials:

1. Sod: Time delivery so that sod will be placed within 24 hours after stripping. Protect sod against drying and breaking of rolled strips.
2. Trees: Provide freshly dug trees. Do not use trees which have been in cold storage or heeled-in. Do not prune prior to delivery. Do not bend or bind-tie trees in such manner as to damage bark, break branches, or destroy natural shape. Provide protective covering during delivery.

3. Dig Balled and Burlapped (BB) plants with firm, natural balls of earth of diameter not less than that specified, and of sufficient depth to include all the fibrous feeding roots. No plant moved with a ball will be accepted if the ball is cracked or broken before or during planting operations, except on special approval.

4. Deliver trees after preparations for planting have been completed and plant immediately. If planting is delayed more than six (6) hours after delivery, set trees in shade, protect from weather and mechanical damage, and keep roots moist.

5. Do not remove container grown stock from containers until planting time.

6. Label at least one (1) tree of each variety with a securely attached waterproof tag bearing legible designation of botanical and common name.

1.06 JOB CONDITIONS:

A. Proceed with and complete the landscape work as rapidly as seasonal limitations for each kind of landscape work required.

B. Utilities: Determine location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required, to minimize possibility of damage to underground utilities. Maintain grade stakes set by others until removal is mutually agreed upon by all parties concerned.

C. Excavation: When conditions detrimental to plant growth are encountered such as rubble fill, adverse drainage conditions, or obstructions, notify Architect before planting.

D. Planting Schedules: Prepare a proposed planting schedule. Schedule the dates for each type of landscape work during the normal seasons for such work in the area of the site. Correlate with specified maintenance periods to provide...
maintenance until occupancy by the Owner. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

E. Coordination with Lawns: Plant trees after final grades are established and prior to planting of lawns, unless otherwise acceptable to the Architect. If planting of trees occurs after lawn work, protect lawn areas and promptly repair damage to lawns resulting from planting operations.

1.07 WARRANTY:

A. Warranty lawns through the specified maintenance period, and until final acceptance.

B. Warranty trees for a period of one (1) year after date of acceptance against defects, including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Landscape Installer's control.

C. Remove and replace trees or other plants found to be dead or in unhealthy condition during warranty period. Plant missing trees and plants. Make replacements during growth season following end of warranty period. Furnish and plant replacements which comply with requirements shown and specified. Also, replace trees which are in doubtful condition at end of warranty period; unless, in the opinion of the Architect, it is advisable to extend warranty period for a full-growing season. The Architect will make another inspection at the end of extended warranty period, if any, to determine acceptance or rejection. Only one replacement will be required at end of warranty period, except for losses or replacement due to failure to comply with specified requirements.

PART 2 - PRODUCTS

2.01 TOPSOIL:

A. Provide new topsoil which is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds, and other litter, and free of roots, stumps, stones larger than 2" in any dimension, and other extraneous or toxic matter harmful to plant growth.
   1. Provide all new topsoil; do not use any on site.
2.02 SOIL AMENDMENTS:

A. Lime: Natural limestone containing not less than 85% of total carbonates, ground so that not less than 90% passes a 10-mesh sieve, and not less than 50% passes a 100-mesh sieve.

B. Peat Humus: FS Q-P-166 and with the texture and ph range suitable for the intended use.

C. Bonemeal: Commercial, raw, finely ground, 4% nitrogen and 20% phosphoric acid.

D. Superphosphate: Soluble mixture of treated minerals; 20% available phosphoric acid.

E. Commercial Fertilizer: Complete fertilizer of neutral character with some elements derived from organic sources and containing the following percentages of available plant nutrients:

1. For trees, provide fertilizer with not less than 10% available phosphoric acid and from 3% to 5% total nitrogen, and from 3% to 5% soluble potash.
2. For lawns, provide fertilizer with not less than 4% phosphoric acid and not less than 2% potassium, and the percentage of nitrogen required to provide not less than 1 lb. of actual nitrogen per 1000 sq.ft. of lawn area. Provide nitrogen in a form that will be available to the lawn during the initial period of growth.

2.03 PLANT MATERIALS:

A. Name and Variety: Provide plant materials true to name and variety established by the American Joint Committee on Horticultural Nomenclature "Standardized Plant Names" Second Edition, 1942. Substitutions or indigenous local specie may be proposed if still deciduous or evergreen as required. Substitutions must be same size or larger. Comply with all other requirements acceptable to the Architect.

B. Quality: Provide trees and other plants complying with the recommendations and requirements of ANSI 760; "Standard for Nursery Stock" and as further specified.
C. Measurements: Measure all trees when their branches are in normal position. Height and spread dimensions indicated refer to the main body of the plant, not from branch or root tip to tip. Determine caliper as follows:

1. For 4" and smaller, measure diameter of trunk 6" above grade.

2. For larger than 4", measure diameter of trunk 12" above grade.

D. Do not cut leaders or otherwise damage by unnecessary cutting.

E. Deciduous Trees: 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. Ball and burlap (BB) deciduous trees.

2.04 GRASS MATERIALS:

A. Sod: Provide strongly rooted sod not less than two (2) years old and free of weeds and undesirable native grasses. Provide only sod capable of growth and development when planted (viable, not dormant) and in strips not more than 18" long. Provide sod composed principally of Kentucky Bluegrass (Poa Pratensis) or its equivalent, as acceptable to the Architect.

2.05 SEED:

A. Seed shall be a mixture composed of the following:

Seeding shall be specified as one of these two mixtures:

Improved Kentucky Bluegrass Mixture

<table>
<thead>
<tr>
<th>Seed Type</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Touchdown Kentucky Bluegrass</td>
<td>6#/1000 Sq. Ft.</td>
</tr>
<tr>
<td>Barron Kentucky Bluegrass</td>
<td>6#/1000 Sq. Ft.</td>
</tr>
</tbody>
</table>

Grass shall be fresh, new crop seed. The Contractor shall furnish the Owner the dealer's guaranteed statement of the composition of the mixture and the percentages of purity and germination and a copy of the State Certification for the seed.
B. Hydro-Seed Option:

The Contractor is advised that he may use hydro-seeding or hydro-mulching operations in lieu of mechanical seeding if he so desires.

2.06 MISCELLANEOUS LANDSCAPE MATERIALS:

A. Anti-Desiccant: Emulsion type, film-forming agent similar to Dowax by Dow Chemical Co. or Wilt-Prof by Nursery Specialty Products, Inc., designed to permit transpiration but retard excessive loss of moisture from plants. Deliver in manufacturer's fully identified containers and mix in accordance with manufacturer's instructions.

B. Wrapping: Tree-wrap tape not less than 4" wide, designed to prevent bore damage and winter freezing fabricated from bituminous lined two-ply paper.

C. Stakes and Guys: Provide stakes and deadmen of sound new hardwood, treated softwood, or redwood, free of knot holes and other defects. Provide wire ties and guys of 2-strand, twisted, pliable galvanized iron wire not lighter than 12 USWG with zinc-coated turnbuckles. Provide net 2-ply fabric black rubber hose not less than 1/2" hose size, cut to required lengths to protect tree trunks from damage by wires.

D. Plastic Sheet: Black, weather resistant polyethylene sheeting complying with FS L-P-512, Type III, 0.008" (6 mils) thick.

E. Mulch: For uses other than with hydro-seeding, operations shall be hay or straw, not chopped in short lengths. Mulch used with hydro-seeking operations shall be a wood cellulose fiber containing no growth or germination inhibiting factors. Rate of application for wood cellulose fiber mulch in hydro-seeking operations shall be 1500 pounds per acre, or 35 pounds per 1000 square feet.

2.07 PREPARATION OF PLANTING SOIL:

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 as provided herein. Delay mixing of fertilizer if planting will not follow placing of planting soil within a few days. Prepare mix on site using four parts topsoil to
one part peat, and add 5 lbs. super phosphate to each cubic yard. Completely mix mechanically and add fertilizer as directed by the Architect.

C. For pit type back fill, mix planting soil prior to back filling and stockpile at the site.

D. For planting beds, mix planting soil either prior to planting or apply on surface of topsoil and mix thoroughly before planting.

1. Mix lime with dry soil prior to mixing of fertilizer.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Installer must examine the subgrade, verify the elevations, observe the conditions under which work is to be performed, and notify the General Contractor of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 PREPARATION:

A. Layout individual tree locations and areas for multiple plantings. Stake locations and outline areas and secure Architect's acceptance before start of planting work. Make minor adjustments as may be requested.

B. Preparation for Planting Lawns:

1. Loosen subgrade of lawn areas to minimum depth of 4". Remove stones over 1-1/2" in any dimension, and sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.

2. Spread topsoil to minimum depth required to meet lines, grades, and elevations shown, but not less than 4" after light rolling and natural settlement.

3. Place approximately 1/2 of total amount of topsoil required. Work into top of loosened subgrade to create a transition layer and then place remainder of topsoil.
4. Allow for sod thickness in areas to be sodded.

5. Grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll and rake and remove ridges and fill depressions as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.

6. Apply fertilizer by mechanical spreading at a rate of not less than 20 lbs. per 1,000 sq. ft.. Blend with top 1" of soil.

7. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.

8. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

9. Preparation of Unchanged Grades: Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows:

   Till to a depth of not less than 6"; apply soil amendments and initial fertilizers as specified; remove high areas and fill in depressions; till soil to a homogenous mixture of fine texture, free of lumps, clods, stones, roots, and other extraneous matter.

   a. Prior to preparation of unchanged areas, remove existing grass, vegetation and turf. Dispose of such material outside of Owner's property; do not turn over into soil being prepared for lawns.

C. Preparation of Planting Beds:
1. Loosen subgrade of planting bed areas to a minimum depth of 6" using a cultimulcher or similar equipment. Remove stones over 1-1/2" in any dimension, and sticks, stones, rubbish, and other extraneous matter.

2. Spread planting soil mixture to minimum depth required to meet lines, grades and elevations shown after light rolling and natural settlement. Place approximately 1/2 of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer, then place remainder of the planting soil.
D. Excavation for Trees:

1. Excavate pits, beds and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.

2. For balled and burlapped, (BB) trees, make excavations at least twice as wide as the ball diameter and equal to the ball depth, plus the following allowance for setting of ball on a layer of compacted back fill. Allow for 4" setting layer of planting soil mixture.

3. Dispose of subsoil removed from landscape excavations. Do not mix with planting soil or use as back fill.

4. Fill excavations for trees with water and allow to percolate out before planting.

3.03 PLANTING:

A. Planting Trees:

1. Set balled and burlapped (BB) stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. When set, place additional soil mixture back fill around base and sides of ball, and work each layer to settle back fill and eliminate voids and air pockets. When excavation is approximately 2/3 full, water thoroughly before placing remainder of back fill. Repeat watering until no more is absorbed. Water again after placing final layer of back fill.

2. Dish top of back fill to allow for mulching.
   a. For spring planting, provide additional back fill berm around edge of excavations to form shallow saucer to collect water.

3. Mulch pits, trenches, and planted areas. Provide not less than 4" and finish level with adjacent finish grades using shredded bark.

4. Apply anti-desiccant using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage.
a. If deciduous trees are moved in full-leaf, spray with anti-desiccant at nursery before moving and again two (2) weeks after planting.

5. Prune, thin out and shape trees in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by the Architect, do not cut tree leaders, and remove only injured or dead branches from flowering trees, if any.

6. Remove and replace excessively pruned or misformed stock resulting from improper pruning.

7. Paint cuts over 1/2" in size with standard tree paint or compound covering exposed, living tissue. Use paint which is waterproof, antiseptic, adhesive, elastic, and free of kerosene, coal tar, creosote, and other substances harmful to plants. Do not use shellac.

8. Wrap trunks of all deciduous trees taller than 8'. Start at ground and cover trunk to height of second limbs and secure at every second wrap.

9. Inspect tree trunks for injury, improper pruning, and insect infestation, and take corrective measures required before wrapping.

10. Guy and stake trees immediately after planting as follows:

   a. Guy three (3) ways securing wire to 2" x 4" x 30" stakes set two (2) feet in the ground.

B. Sodding New Lawns:

1. Lay sod within 24 hours from time of stripping. Do not plant dormant sod or if ground is frozen.

2. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering of adjacent grass.
3. Secure sod on slopes with wood pegs to prevent slippage.

4. Water sod thoroughly with a fine spray immediately after planting.

C. Mechanical Seeding:

1. Seeding: The Contractor shall seed all areas with grass seed as specified, sowing evenly with an approved mechanical seeder at the rate specified in 2.05A. Sow one-half the seed in one direction and the other half at right angles to the first seeding. To cover the seed and firm the soil, the seed bed shall then be lightly rolled with a cultipacker. In areas inaccessible to the cultipacker, the seeded ground shall be lightly raked and rolled in two directions with water ballast roller. Extreme care shall be taken during seeking and raking to insure that no change shall occur in the finished grades and that the seed is not raked from one spot to another. If the areas are seeded by a large mechanical seeder which works the seed into the soil and at the same time rolls the seed bed, it is not necessary to roll the seed bed separately.

2. Mulching: After sowing, mulch shall be spread evenly at the rate of 2 tons per acre over newly seeded areas. The mulch shall be applied in a uniform layer, loose enough to allow sunlight to penetrate and air to circulate, yet sufficient to shade the soil and reduce erosion. The mulch shall be held in place by crimping, cultipacking, spraying with asphalt emulsion, or any other means satisfactory with the Owner.

D. Hydraulic Seeding (option):

1. The Contractor shall seed with hydraulic seeding equipment, using fertilizer and mulch of the type and at the rate previously specified. Slurry shall be distributed uniformly over the area at the designated application rate. Areas inaccessible to such equipment may be fertilized and seeded by hand.

3.04 MISCELLANEOUS LANDSCAPE WORK:

A. Place wood chip mulch beds where shown. Compact soil sub grades and lay 6 mil carbonated polyethylene film over compacted subgrade prior to placing mulch.
3.05 MAINTENANCE:

A. Begin maintenance immediately after planting.

B. Maintain trees and other plants until final acceptance, but in no case less than 30 days after planting.

C. Maintain trees and other plants by pruning, cultivating, and weeding as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports, and reset trees to proper grades or vertical position as required. Restore or replace damaged wrapping. Spray as required to keep trees free of insects and disease. Feed trees as specified and as may be required.

D. Feeding Program:

1. Feed all trees at least one time prior to final acceptance. Schedule feeding as follows:

   a. For Spring and early Summer planting, feed shortly after installation.

   b. For late Summer and Fall planting, feed the following Spring.

2. Rake back mulch, apply fertilizer, and replace mulch. Fertilize with 10-6-4 analysis fertilizer, applying uniformly over cultivated ground area surrounding each plant. Apply fertilizer at the following rates:

   a. Shade trees - 2 lbs. per inch of caliper.

   b. Small trees - 1 lb. per inch of caliper.

E. Maintain lawns as indicated in Section 02499 “Landscape Maintenance and Warranty Standards”.

1. Maintain lawns by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading and replanting as required to establish a smooth, acceptable lawn free of eroded or bare areas.

3.06 CLEAN UP AND PROTECTION:

A. During landscape work, store materials and equipment where directed. Keep pavements clean and work area in an orderly condition.
B. Protect landscape work and materials from damage due to landscape operations, operations by other contractors, trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

3.07 INSPECTION AND ACCEPTANCE:

A. When the landscape work is completed including maintenance, the Architect will, upon request, make an inspection to determine acceptability.

B. Where inspected landscape work does not comply with the requirements, replace rejected work and continue specified maintenance until reinspected by the Architect and found to be acceptable. Remove rejected plants and materials promptly from the project site.

END OF SECTION 02480
PART 1 - GENERAL

1.01 RELATED DOCUMENTS:
A. Attention is directed to Bidding and Contract Requirements, and to General and Supplemental Conditions, hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:
A. The requirements of this Section include a one year warranty period from date of acceptance of installation.

B. Related Work Specified Elsewhere:
   1. Section 02480: Landscape Work

1.03 ACCEPTANCE OF INSTALLATION:
A. At the completion of all landscape installation, or pre-approved portions thereof, the Landscape Contractor shall request in writing an inspection for acceptance of installation in which the Landscape Contractor, Landscape Architect and Owner's Representative shall be present. After this inspection a "Punch List" will be issued by the Landscape Architect and/or Owner's Representative shall re-inspect the project and issue a written statement of acceptance of installation and establish the beginning of the project warranty period.

B. Landscape work may be inspected for acceptance in parts agreeable to Owner's Representative and Landscape Architect provided work offered for inspection is complete, including maintenance as required.

C. For work to be inspected for partial acceptance, Contractor shall provide a drawing outlining work completed, and supply a written statement requesting acceptance of this work completed to date.

1.04 PROJECT WARRANTY:
A. The project warranty period begins upon written acceptance of the project installation by Landscape Architect and Owner's Representative.
B. The Landscape Contractor shall guarantee seeded areas through construction and for a period of one year after date of acceptance of installation against defects including death and unsatisfactory growth, except for defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond Landscape Contractor's control.

1.05 MAINTENANCE:

A. To insure guarantee standards, the following maintenance procedures shall be executed during construction and for the full project warranty period.

B. Maintenance of Seeded Lawn Areas:

1. The Contractor shall establish a dense lawn of permanent grasses, free from lumps and depressions or any bare spots, none of which is larger than one foot of area up to a maximum of 3% of the total seeded lawn area. Any part of the seeded lawn that fails to show a uniform growth and/or germination shall be reseeded until a dense cover is established.

2. If seeded in fall or if not considered acceptable at that time, continue maintenance the following spring until acceptable lawn is established.

3. The Contractor shall provide a minimum of two cuttings of the lawn or more as necessary until the inspection and acceptance of installation by the Owner's Representative and Landscape Architect. When the lawn reaches 3 inches in height it shall be cut to 2 inches in height. When meadow lawn reaches 6" in height it shall be cut to 4" in height.

4. The Owner assumes cutting responsibilities following the acceptance of installation by the Owner's Representative and the Landscape Architect.

5. After acceptance of installation, and for the duration of the project warranty period the Landscape Contractor shall continue all other maintenance procedures including fertilizing and weeding, and other operations such as rolling, regrading, replanting, and applying herbicides, fungicides, insecticides as required to establish a smooth, acceptable lawn free of eroded or bare areas.
6. Repair, rework, and reseed all areas that have washed out, and eroded, or do not substantially germinate.

7. At conclusion of project warranty period and after receiving written final acceptance by Owner's Representative and Landscape Architect, the Owner shall assume all seeded lawn maintenance responsibilities.

1.06 FINAL ACCEPTANCE:

A. At the conclusion of the project warranty period the Landscape Contractor shall request a project inspection for final acceptance in which the Landscape Contractor, Landscape Architect and Owner's Representative shall be present. After this inspection a "Punch List" will be issued by the Landscape Architect. Upon completion of all punch list items, the Landscape Architect and Owner's Representative shall reinspect the project and issue a written statement of final acceptance. Upon final acceptance the Owner assumes all maintenance responsibilities for the landscape of the project.

PART 2 AND 3 - PRODUCTS AND EXECUTION

Not Applicable.

END OF SECTION 02499
SECTION 02530 - SANITARY SEWERAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes sanitary sewerage outside the building.

B. Related Sections include the following:
   1. Section 02300 “Earthwork.”
   2. Section 02630 "Storm Drainage."

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

1.5 SUBMITTALS

A. Shop Drawings: Include plans, elevations, details, and attachments for the following:
   1. Precast concrete manholes, including frames and covers.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify General Contractor and Owner not less than 72 hours in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without General Contractor and Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES AND FITTINGS

A. PVC Sewer Pipe and Fittings: According to the following:

1. PVC Sewer Pipe and Fittings: ASTM D 3034, Schedule 40, for solvent-cemented or gasketed joints.
   a. Primer: ASTM F 656.
2.2 MANHOLES

A. Normal-Traffic Precast Concrete Manholes: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.
   1. Diameter: 48 inches minimum, unless otherwise indicated.
   2. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
   3. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
   4. Riser Sections: 4-inch minimum thickness, and lengths to provide depth indicated.
   5. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
   7. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch diameter frame and cover.

B. Manhole Frames and Covers: ASTM A 536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange, and 26-inch- diameter cover. Include indented top design with lettering as indicated on local municipalities standard plans. Provide type and model of casting as indicated on local municipalities standard plans.
2.3 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.

B. Structures; Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio.

2. Reinforcement Bars: ASTM A 615, Grade 60, deformed steel.

C. Structure Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water-cementitious materials ratio. Include channels and benches in manholes.

1. Manhole Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
   a. Invert Slope: 1 percent through manhole.

2. Manhole Benches: Concrete, sloped to drain into channel.
   a. Slope: 8 percent.

2.4 CLEANOUTS

A. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.
PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 02300 "Earthwork" and with requirements of local municipalities.

3.2 IDENTIFICATION

A. Materials and their installation are specified in Division 2 Section "Earthwork." Arrange for installing green warning tapes directly over piping and at outside edges of underground structures.

   1. Use warning tape or detectable warning tape over ferrous piping.
   2. Use detectable warning tape over nonferrous piping and over edges of underground structures.

3.3 PIPING APPLICATIONS

A. General: Include watertight joints.

B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.

C. Gravity-Flow Piping: Use the following:

   1. NPS 4 and NPS 8: PVC sewer pipe and fittings, solvent-cemented joints, or gaskets and gasketed joints.

3.4 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and
arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

C. Use manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

D. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow system piping at constant slope between points and elevations indicated.

1. Install straight piping runs at constant slope, not less than that specified, where slopes are not indicated.

3.5 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to installations indicated.

B. PVC Sewer Pipe and Fittings: As follows:

1. Join pipe and gasketed fittings with elastomeric seals according to ASTM D 2321.
2. Join solvent cement joint pipe and fittings with solvent cement according to ASTM D 2855 and ASTM F 402.

3. Install according to ASTM D 2321.

C. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.

D. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

3.6 MANHOLE INSTALLATION

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Form continuous concrete channels and benches between inlets and outlet.

C. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere, unless otherwise indicated.

D. Install precast concrete manhole sections with gaskets according to ASTM C 891.

   1. Provide rubber joint gasket complying with ASTM C 443 at joints of sections.

E. Construct cast-in-place manholes as indicated.

F. Install fiberglass manholes according to manufacturer's written instructions.

3.7 CLEANOUT INSTALLATION

A. Install cleanouts and riser extension from sewer pipe to cleanout at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil
pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.

B. Set cleanout frames and covers in earth in cast-in-place concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade.

C. Set cleanout frames and covers in concrete pavement with tops flush with pavement surface.

3.8 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so finished Work complies as nearly as practical with requirements specified for new Work.

B. Make branch connections to underground structures by cutting opening into structure large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through structure wall to conform to shape of and be flush with inside wall, unless otherwise indicated. On outside of structure wall, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

1. Use concrete that will attain minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

2. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

C. Protect piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.9 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or
drag in piping, and pull past each joint as it is completed.

1. Place plug in end of incomplete piping at end of day and when work stops.
2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate reports for each test.
5. Perform tests according to procedures of authorities having jurisdiction.

END OF SECTION 02530
SECTION 02620 - SUBDRAINAGE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes subdrainage systems for the following:
   1. Catch basins.

B. Related Section includes the following:
   1. Section 02530 “Sanitary Sewerage”
   2. Section 02630 “Storm Drainage”

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride.

1.4 SUBMITTALS

A. Product Data: For drainage conduit, drainage panels, and geotextile fabrics.
   1. Perforated pipe.
   2. Geotextile fabrics.

PART 2 - PRODUCTS

2.1 DRAINAGE PIPES AND FITTINGS

A. Perforated, Corrugated PVC Sewer Pipe and Fittings: ASTM ASTM F 800, bell-and-spigot ends, for loose joints except perforations shall conform to requirements of AASHTO M252.

2.2 SOIL MATERIALS

A. Pea Gravel: Clean, hard, durable, free flowing, naturally rounded particles of rock, free from clay lumps, with 100%
passing a 3/8@ sieve and not over 5% passing a #8 sieve.

2.3 GEOTEXTILE FILTER FABRICS

A. Woven or nonwoven geotextile filter fabric of PP or polyester fibers, or combination of both. Flow rates range from 110 to 330 gpm per sq. ft. when tested according to ASTM D 4491. Available styles are flat and sock.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 02300 "Earthwork."

3.2 CATCH BASIN SUBDRAINAGE INSTALLATION

A. Place supporting layer of pea gravel over compacted subgrade to compacted depth of not less than 4 inches. After installing drainage piping, add pea gravel to top of pipe to perform tests. After satisfactory testing, cover piping with pea gravel to elevation of bottom of aggregate base course and compact pea gravel material.  

3.3 PIPING INSTALLATION

A. Install piping beginning at low points of system, true to grades and alignment indicated, with unbroken continuity of invert. Bed piping with full bearing in filtering material. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions and other requirements indicated.
1. Install piping pitched down in direction of flow as indicated on Drawings.
2. Lay perforated pipe with perforations down.
3. Excavate recesses in trench bottom for bell ends of pipe. Lay pipe with bells facing upslope and with spigot end entered fully into adjacent bell.

B. Install PVC piping according to ASTM D 2321.
3.4 FIELD QUALITY CONTROL

A. Testing: After installing drainage fill to top of pipe, test drain piping with water to ensure free flow before backfilling. Remove obstructions, replace damaged components, and repeat test until results are satisfactory.

3.5 CLEANING

A. Clear interior of installed piping and structures of dirt and other superfluous material as work progresses. Maintain swab or drag in piping and pull past each joint as it is completed. Place plugs in ends of uncompleted pipe at end of each day or when work stops.

END OF SECTION 02620
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes storm drainage outside the building.

B. Related Sections include the following:

1. Section 02300 “Earthwork.”
2. Section 02530 “Sanitary Sewerage.”
3. Section 02620 “Subdrainage.”

1.3 DEFINITIONS

A. PVC: Polyvinyl chloride plastic.

B. Drainage Piping: System of piping, fittings and appurtenances for gravity flow of storm drainage.

1.4 PERFORMANCE REQUIREMENTS

A. Gravity-Flow, Nonpressure-Piping Pressure Ratings: At least equal to system test pressure.

1.5 SUBMITTALS

A. Shop Drawings: Include plans, elevations, details, and attachments for the following:
1. Precast concrete manholes and other structures, including frames, covers, and grates.

B. Design Mix Reports and Calculations: For each class of cast-in-place concrete.

C. Field Test Reports: Indicate and interpret test results for compliance with performance requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic structures, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

1.7 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.

B. Locate existing structures and piping to be closed and abandoned.

C. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify the General Contractor and Owner not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without General Contractor’s and Owner’s written permission.

PART 2 - PRODUCTS
2.1 PIPES AND FITTINGS

A. PVC Sewer Pipe and Fittings: According to the following:

1. ASTM D 3034, Schedule 40, for solvent-cemented or gasketed joints.
   a. Primer: ASTM F 656
   b. Solvent Cement: ASTM D 2564

B. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76, Class III, Wall B for gasketed joints.


2.2 CATCH BASINS

A. Normal-Traffic, Precast Concrete Catch Basins: ASTM C 478, precast, reinforced concrete, of depth indicated, with provision for rubber gasketed joints.

1. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and having separate base slab or base section with integral floor.
2. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
3. Top Section: Eccentric-cone type, unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
5. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and grate.

6. Steps: Manufactured from deformed, 3/8-inch minimum steel reinforcement rod complying with ASTM A 615 and encased in polypropylene complying with ASTM D 2416 “Propylene Plastic Molding and Extrusion Materials”. Steps shall comply with local utility company
stands. Omit steps on catch basins less than 60 inches deep.

7. Pipe Connectors: ASTM C 923, resilient, of size required, for each pipe connecting to base section.

B. Frames and Grates: ASTM A 536, Grade 60-40-18, ductile iron designed for heavy-duty service. Include flat grate with small square or short-slotted drainage openings.

1. Size: 24 by 24 inches minimum, unless otherwise indicated.
2. Grate Free Area: Approximately 50 percent, unless otherwise indicated.

2.3 CONCRETE

A. General: Cast-in-place concrete according to ACI 318, ACI 350R, and the following:

1. Cement: ASTM C 150, Type II.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water-cementitious ratio.

2. Reinforcement Bars: ASTM A 615, Grade 60, deformed steel.

2.4 CLEANOUTS

A. Cleanouts: ASME A112.36.2M, round, cast-iron housing with clamping device and round, secured, scoriated, cast-iron cover. Include cast-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass
closure plug. Use units with top-loading classifications according to the following applications:

1. Light Duty: In earth or grass foot-traffic areas.
2. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 02300 "Earthwork."

3.2 PIPING APPLICATIONS

A. General: Include watertight, silttight, or soiltight joints, unless watertight or silttight joints are indicated.

B. Refer to Part 2 of this Section for detailed specifications for pipe and fitting products listed below. Use pipe, fittings, and joining methods according to applications indicated.

C. Gravity-Flow Piping: Use the following:

1. NPS 4 and NPS 8: PVC sewer pipe and fittings, solvent-cemented joints, or gaskets and gasketed joints.
2. NPS 12 to NPS 48: Reinforced-concrete sewer pipe and fittings, gaskets, and gasketed joints.
3.3 INSTALLATION, GENERAL

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab or drag in line, and pull past each joint as it is completed.

C. Use proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

D. Install gravity-flow piping and connect to building's storm drains, of sizes and in locations indicated. Terminate piping as indicated.

1. Install piping pitched down in direction of flow, at minimum slope of 1 percent, unless otherwise indicated.
2. Install piping with 36-inch minimum cover.

3.4 PIPE JOINT CONSTRUCTION AND INSTALLATION

A. General: Join and install pipe and fittings according to installations indicated.

B. PVC Sewer Pipe and Fittings: As follows:

1. Join solvent-cement joint pipe and fittings with solvent cement according to ASTM D 2855 and ASTM F 402.
2. Join pipe and gasketed fittings with gaskets according to ASTM D 2321.
3. Install according to ASTM D 2321.

C. Concrete Pipe and Fittings: Install according to ACPA's "Concrete Pipe Installation Manual." Use the following seals:


D. System Piping Joints: Make joints using system manufacturer's couplings, unless otherwise indicated.

E. Join piping made of different materials or dimensions with couplings made for this application. Use couplings that are compatible with and that fit both systems' materials and dimensions.

3.5 CATCH-BASIN INSTALLATION

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.6 CONCRETE PLACEMENT

A. Place cast-in-place concrete according to ACI 318 and ACI 350R.

3.7 TAP CONNECTIONS

A. Make connections to existing piping and underground structures so finished Work complies as nearly as practical with requirements specified for new Work.

B. Protect existing piping and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.
3.8 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. In large, accessible piping, brushes and brooms may be used for cleaning.
2. Place plug in end of incomplete piping at end of day and when work stops.
3. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

B. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.
2. Defects requiring correction include the following:
   a. Alignment: Less than full diameter of inside of pipe is visible between structures.
   b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
   c. Crushed, broken, cracked, or otherwise damaged piping.
   d. Infiltration: Water leakage into piping.
   e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks
and defects in accordance with local municipalities requirements.

1. Do not enclose, cover, or put into service before inspection and approval.
2. Test completed piping systems according to authorities having jurisdiction.
3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
4. Submit separate reports for each test.
5. Leaks and loss in test pressure constitute defects that must be repaired.
6. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION 02630
SECTION 02665 - WATER DISTRIBUTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes water systems piping for potable water service and fire protection service outside the building.

1.3 SYSTEM PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure Ratings: Except where otherwise indicated, the following are minimum pressure requirements for water system piping.

1. Underground Piping: 150 psig (1035 kPa).

1.4 SUBMITTALS

A. General: Submit the following according to Conditions of the Contract and Division 1 Specification Sections.

B. Product data, including pressure rating, rated capacity, and settings of selected models for the following:

1. Valves.
2. Fire hydrants.

C. Shop drawings for precast concrete pits. Include frames and covers. Include drains when indicated.

1.5 QUALITY ASSURANCE

A. Comply with requirements of utility supplying water.

B. Comply with standards of authorities having jurisdiction for fire protection systems. Include materials, hose threads, installation, and testing.

C. Comply with standards of authorities having jurisdiction for
potable water piping and plumbing systems. Include materials, installation, testing, and disinfection.

D. Provide listing/approval stamp, label, or other marking on equipment made to specified standards.

E. Product Options: Water systems specialties and accessories are based on specific types, manufacturers, and models indicated. Components by other manufacturers but having equal performance characteristics may be considered, provided deviations in dimensions, operation, and other characteristics do not change design concept or intended performance as judged by Architect. The burden of proof of equality of products is on Contractor.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Preparation for Transport: Prepare valves, including fire hydrants, for shipping as follows:

1. Ensure that valves are dry and internally protected against rust and corrosion.
2. Protect valves against damage to threaded ends, flange faces, and weld ends.
3. Set valves in best position for handling. Set valves closed to prevent rattling.

B. Storage: Use the following precautions for valves, including fire hydrants, during storage.

1. Do not remove end protectors unless necessary for inspection; then reinstall for storage.
2. Protect valves from weather. Store valves indoors and maintain temperature higher than ambient dew point temperature. Support valves off-ground or pavement watertight enclosures when outdoor storage is necessary.

C. Handling: Use sling to handle valves and fire hydrants whose size requires handling by crane or lift. Rig valves to avoid damage to exposed valve parts. Do not use handwheels or stems as lifting or rigging points.

D. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.
E. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. Do not exceed structural capacity of floor when storing inside.

F. Protect flanges, fittings, and piping specialties from moisture and dirt.

1.7 PROJECT CONDITIONS
A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Verify that water system piping may be installed in compliance with original design and referenced standards.

1.8 SEQUENCING AND SCHEDULING
A. Coordinate connection to water main with utility company, Construction Manager and Owner.

B. Coordinate with pipe materials, sizes, entry locations, and pressure requirements of fire protection systems piping.

C. Coordinate with other utility work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Manufacturers: Subject to compliance with the Shelby Township Standard Specifications for Construction and the Standard Water Main Detail Sheet:

1. Drilling Machine Corporation Stops:
   a. Mueller Co., Grinnell Corp. (H15000)

2. Brass Corporation Stops and Valves:
   a. Ford Meter Box Co., Inc.
   b. Hays Div., Romac Industries
   c. A.Y. McDonald Mfg. Co.
3. Gate Valves:
   b. Clow Valve Co. Div., McWane, Inc.
   c. East Jordan Iron Works, Inc.
   d. Gem Sprinkler Co. Div., Grinnell Corp.
   e. Hammond Valve Corp.
   f. Kennedy Valve Div., McWane, Inc.
   g. Milwaukee Valve Co., Inc.
   h. Mueller Co., Grinnell Corp.
   i. Nibco, Inc.
   j. Stockham Valves & Fittings, Inc.
   k. U.S. Pipe & Foundry Co.
   l. Waterous Co.

4. Dry-Barrel Fire Hydrants:
   b. Mueller Co., Grinnell Corp.
   c. Traverse City Iron Works.

2.2 PIPES AND TUBES

A. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube materials specified below are used.

B. Ductile-Iron Pipe: AWWA C151, Class 54.

1. Lining: AWWA C104, double cement lining with bituminous seal coat.
2. Gaskets, Glands, and Bolts and Nuts: AWWA C111.
4. Mechanical-Joint-Type Pipe: AWWA C111, rubber gaskets, ductile- or cast-iron glands, and steel bolts and nuts.

2.3 PIPE AND TUBE FITTINGS

A. Refer to Part 3 Article "Piping Applications" for identification of systems where pipe and tube fitting materials specified below are used.

1. Lining: AWWA C104, cement mortar.
2. Gaskets: AWWA C111, rubber.

2.4 JOINING MATERIALS

A. Refer to Part 3 Article "Piping Applications" for identification of systems where joining materials specified below are used.

B. Ductile-Iron Pipe and Ductile-Iron or Cast-Iron Fittings: The following materials apply:

2. Mechanical Joints: AWWA C111 ductile-iron or gray-iron glands, high-strength steel bolts and nuts, and rubber gaskets.

3. Flanged Joints: AWWA C115 ductile-iron or gray-iron pipe flanges, rubber gaskets, and high-strength steel bolts and nuts.
   a. Gaskets: Rubber, flat face, 1/8 inch (3 mm) thick except where other thickness is indicated; and full-face or ring type except where other type is indicated.
   b. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.

C. Pipe Couplings: Iron-body sleeve assembly, fabricated to match outside diameters of pipes to be joined.

2. Followers: ASTM A 47, Grade 32510, or ASTM A 536 ductile iron.
5. Finish: Enamel paint.

2.5 VALVES

A. Furnish and install in accordance with the Shelby Township Standard Specifications for construction and the Standard Water Main Detail Sheet.
B. Nonrising Stem Gate Valves 3 Inches (80 mm) and Larger: AWWA C500, cast-iron double disc, bronze disc and seat rings, bronze stem, cast-iron or ductile-iron body and bonnet, stem nut, 200-psig (1380 kPa) working pressure, mechanical joint ends. The direction of turning to open shall be left.

C. Valve Boxes: Cast-iron box having top section and cover with lettering "WATER", bottom section with base of size to fit over valve and barrel approximately 5 inches (124 mm) in diameter, and adjustable cast-iron extension of length required for depth of bury of valve.

2.6 FIRE HYDRANTS

A. Furnish and install in accordance with the Shelby Township Standard Specifications for Construction and the Standard Water Main Detail Sheet.

B. General: Cast-iron body, compression-type valve, opening against pressure and closing with pressure, 6-inch (150 mm) mechanical joint inlet, 150-psig (1035 kPa) working pressure.

C. Outlet Threads: NFPA 1963, with external hose thread used by local fire department. Include cast-iron caps with steel chains.

D. Operating and Cap Nuts: Pentagon 7/16 inch (40 mm) point to flat.

E. Direction of Opening: Open hydrant valve by turning operating nut to the left, or counterclockwise.

F. Finish: Yellow exterior alkyd gloss enamel paint.

G. Dry-Barrel Fire Hydrants: AWWA C502, two 2-1/2-inch (65mm) and one 4-1/2-inch (113 mm) outlets, 5-1/4-inch (133 mm) main valve, drain valve, and 6-inch (150 mm) mechanical joint inlet.

2.7 ANCHORAGES


C. Rod Couplings: ASTM A 197, malleable iron.


E. Cast-Iron Washers: ASTM A 126, gray iron.

F. Concrete Reaction Backing: Portland cement concrete mix, 2500 psi (20.7 Mpa) at 28 days.
   2. Fine Aggregate: ASTM C 33, crushed sand.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Section 02300 "Earthwork".

3.2 PIPING APPLICATIONS

A. Refer to Part 2 of this Section for detailed specifications for pipe and fittings products listed below. Use pipe, tube, fittings, and joining methods according to the following applications. Piping in pits and inside building may be joined with flanges or couplings, instead of joints indicated, for grooved-end AWWA-size piping.

B. Use pipe, tube, fittings, and joining methods according to following applications:

   1. 4 Inches (100 mm) to 12 inches (300 mm): Class 250, ductile-iron pipe, ductile-iron compact fittings, and push-on or mechanical joints.

3.3 JOINT CONSTRUCTION

A. Ductile-Iron Piping Gasketed Joints: Construct joints according to AWWA C600.

B. Flanged Joints: Align flanges and install gaskets. Assemble
joints by sequencing bolt tightening. Use lubricant on bolt threads.

3.4 PIPING SYSTEMS - COMMON REQUIREMENTS

A. General Locations and Arrangements: Drawings indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated except where deviations to layout are approved on coordination drawings.

B. Install piping at indicated slope.

C. Install components having pressure rating equal to or greater than system operating pressure.

D. Install piping free of sags and bends.

E. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

F. Install fittings for changes in direction and branch connections.

3.5 PIPING INSTALLATION

A. Water Main Connection: Tap water main with size and in location as indicated according to requirements of water utility.

B. Install ductile-iron pipe and ductile-iron and cast-iron fittings according to AWWA C600.

C. Bury piping at minimum depth of 5 feet below finished grade and in accordance with the Shelby Township Standard Specifications for Construction and the Standard Water Main Detail Sheet.

3.6 ANCHORAGE INSTALLATION

A. Anchorages: Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include
anchorages for the following piping systems:

B. Apply full coat of asphalt or other acceptable corrosion-retarding material to surfaces of installed ferrous anchorage devices.

3.7 VALVE INSTALLATION

A. General Application: Use mechanical-joint-end valves for 3-inch (80 mm) and larger buried installation. Use threaded-and flanged-end valves for installation in pits and inside building.

B. AWWA-Type Gate Valves: Comply with AWWA C600. Install buried valves with stem pointing up and with cast-iron valve box, unless noted otherwise on local Municipalities' standard detail sheets.

3.8 FIRE HYDRANT INSTALLATION

A. AWWA-Type Fire Hydrants: Comply with AWWA M17. Install with gate valve and provision for drainage as indicated.

3.9 FIELD QUALITY CONTROL

A. Hydrostatic Tests: The test shall be made at a pressure of 150 pounds per square inch for water main. The full pressure shall be maintained in each section being tested, by pumping water into the pipe for a period of at least 2 hours. Any faulty pipe, fittings, gate valves or other accessories discovered during testing shall be replaced with sound material, and the test shall be repeated until specific requirements are met. The maximum permissible leakage (as measured by the amount of water pumped into the pipe during the test period) shall not exceed a rate of 0.10 gallons per hour per inch diameter of main per 1000 linear feet of pipe. All tests shall be coordinated with and witnessed by the local agency having jurisdiction over the water system.

3.10 CLEANING

A. Clean and disinfect water distribution piping as follows:
1. Purge new water distribution piping systems and parts of
existing systems that have been altered, extended, or repaired prior to use.

2. Use purging and disinfecting procedure prescribed by authority having jurisdiction or, if method is not prescribed by that authority, use procedure described in AWWA C651 or as described below:

a. Comply with NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.
b. Fill system or part of system with water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) system or part thereof and allow to stand for 24 hours.
c. Drain system or part of system of previous solution and refill with water/chlorine solution containing at least 200 parts per million of chlorine; isolate and allow to stand for 3 hours.
d. Following allowed standing time, flush system with clean, potable water until chlorine does not remain in water coming from system.
e. Submit water samples in sterile bottles to authority having jurisdiction. Repeat procedure if biological examination made by authority shows evidence of contamination.

B. Prepare reports for purging and disinfecting activities.

END OF SECTION 02665
SECTION 02740 - HOT-MIX ASPHALT PAVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. All work to be performed under this Section shall be in accordance with the Shelby Township Paving Standard Detail sheets.

1.2 SUMMARY

A. Work under this Section includes the following:

1. Hot-mix asphalt paving.
2. Hot-mix asphalt patching.

B. Related Sections include the following:

1. Section 02300 "Earthwork."
2. Section 02751 "Concrete Pavement"

1.3 DEFINITIONS


B. MDOT: Michigan Department of Transportation.

C. HMA: Hot Mix Asphalt

1.4 SYSTEM DESCRIPTION

A. Provide hot-mix asphalt paving according to materials, workmanship, and other applicable requirements of standard specifications of the following:

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

B. Job-Mix Designs: For each job mix proposed for the Work.

C. Material Test Reports: For each paving material.

D. Material Certificates: For each paving material, signed by manufacturers.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer.

1. Manufacturer shall be a paving-mix manufacturer registered with and approved by authorities having jurisdiction or the Michigan Department of Transportation.

B. Testing Agency Qualifications: Qualified according to ASTM D 3666 for testing indicated, as documented according to ASTM E 548.

C. Regulatory Requirements: Comply with State of Michigan, Department of Transportation (MDOT), and 2012 Standard Specification for Construction.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply HMA materials if subbase is wet or excessively damp or if the following conditions are not met:

1. Prime and Tack Coats: Minimum surface temperature of 60 deg F.
2. Slurry Coat: Comply with weather limitations of ASTM D 3910.
3. Asphalt Base Course: Minimum surface temperature of 40 deg F and rising at time of placement.
4. Asphalt Surface Course: Minimum surface temperature of 60 deg F at time of placement.
PART 2 - PRODUCTS

2.1 AGGREGATES

A. Mineral Filler: ASTM D 242, rock or slag dust, hydraulic cement, or other inert material.

B. Paving Mixture Aggregates

1. Fine Aggregates shall conform to MDOT Designation 1300T, 1300L and 700C.
2. Mineral Filler shall conform to MDOT Designation 3MF.

2.2 ASPHALT MATERIALS

A. Bond Coat: SS-1H.

2.3 MIXES

A. Hot-Mix Asphalt: Provide dense, hot-laid, hot-mix asphalt plant mixes designed according to procedures in Michigan Department of Transportation “2003 Standard Specifications for Construction”.

B. Emulsified-Asphalt Slurry: ASTM D 3910, Type I, consisting of emulsified asphalt, fine aggregate, and mineral fillers.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to support paving and imposed loads.

B. Proof-roll subbase using heavy, pneumatic-tired rollers to locate areas that are unstable or that require further compaction.

C. Proceed with paving only after unsatisfactory conditions have been corrected.
3.2 PATCHING

A. Hot-Mix Asphalt Pavement: Sawcut perimeter of patch to full depth and excavate existing pavement section to sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into adjacent sound pavement, unless otherwise indicated. Excavate trench as required for utility installation. Maintain maximum 1:1 side slopes on utility trench. Backfill trench and compact per Section 2300 “Earthwork.”

B. Tack Coat: Apply uniformly to vertical surfaces abutting or projecting into new, hot-mix asphalt paving at a rate of 0.05 to 0.15 gal./sq. yd.
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances and surroundings. Remove spillages and clean affected surfaces.

C. Patching: Place and compact asphalt pavement per paving sections shown on construction drawings. Finish flush with adjacent surfaces.

3.3 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.
   1. Sweep loose granular particles from surface of unbound-aggregate base course. Do not dislodge or disturb aggregate embedded in compacted surface of base course.

3.4 PLACING HOT-MIX ASPHALT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
1. Place hot-mix asphalt base course in the number of lifts and thicknesses indicated.
2. Place hot-mix asphalt wearing course in single lift.
3. Spread mix at minimum temperature of 250 deg F.
4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes, unless otherwise indicated.
5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.

1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Complete a section of asphalt base course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.5 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
3. Offset transverse joints, in successive courses, a minimum of 24 inches.
4. Construct transverse joints as described in AI MS-22, "Construction of Hot Mix Asphalt Pavements."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without displacement.
6. Compact HMA at joints to a density within 2 percent of specified course density.
3.6 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Average Density: 96 percent of reference laboratory density according to AASHTO T 245, but not less than 94 percent nor greater than 100 percent.
2. Average Density: 92 percent of reference maximum theoretical density according to ASTM D 2041, but not less than 90 percent nor greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.
G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.7 INSTALLATION TOLERANCES

A. Thickness: Compact each course to produce the thickness indicated within the following tolerances:

1. Leveling Course: Plus or minus 1/2 inch.
2. Wearing Course: Plus 1/4 inch, no minus.

B. Surface Smoothness: Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:

1. Leveling Course: 1/4 inch.
2. Wearing Course: 1/8 inch.
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch.

3.8 FIELD QUALITY CONTROL

A. Testing Agency: A qualified independent testing and inspecting agency will be engaged by the Owner to perform field tests and inspections and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from specified requirements.

B. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

C. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined according to ASTM D 3549.
D. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement according to ASTM D 979 or AASHTO T 168.

1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared according to ASTM D 2041, and compacted according to job-mix specifications.
2. In-place density of compacted pavement will be determined by testing core samples according to ASTM D 1188 or ASTM D 2726.

   a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than 3 cores taken.
   b. Field density of in-place compacted pavement may also be determined by nuclear method according to ASTM D 2950 and correlated with ASTM D 1188 or ASTM D 2726.

F. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.9 DISPOSAL

A. Remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.

1. Do not allow excavated materials to accumulate on-site.
SECTION 02751 - CONCRETE PAVEMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Curbs and gutters.
2. Walkways.
3. Drives

B. Related Sections include the following:

1. Section 02300 "Earthwork" for subgrade preparation, grading, and base course.
2. Section 03001 "Concrete Work" for general building applications of concrete.

1.3 SUBMITTALS

A. Product Data: For each type of manufactured material and product indicated.

B. Design Mixes: For each concrete pavement mix. Include alternate mix designs when characteristics of materials, project conditions, weather, test results, or other circumstances warrant adjustments.

C. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated, based on comprehensive testing of current materials:

1.4 QUALITY ASSURANCE
A. Installer Qualifications: An experienced installer who has completed pavement work similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

B. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 to conduct the testing indicated, as documented according to ASTM E 548.

C. Concrete Testing Service: Owner will engage a qualified independent testing agency to perform material evaluation tests and determine whether tested work complies with or deviates from specified requirements.

1.5 PROJECT CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, smooth exposed surfaces.

1. Use flexible or curved forms for curves of a radius 100 feet or less.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.

2.2 STEEL REINFORCEMENT
A. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

B. Reinforcement Bars: ASTM A 615, Grade 60, deformed.

C. Plain Steel Wire: ASTM A 82, as drawn.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcement bars, welded wire fabric, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete or fiber-reinforced concrete of greater compressive strength than concrete, and as follows:

1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

A. General: Use the same brand and type of cementitious material from the same manufacturer throughout the Project.

B. Portland Cement: ASTM C 150, Type I.

1. Fly Ash: Not allowed.

C. Aggregate: ASTM C 33, uniformly graded.

1. Do not use fine or coarse aggregates containing substances that cause spalling.

D. Water: ASTM C 94.

2.4 ADMIXTURES
A. General: Admixtures certified by manufacturer to contain not more than 0.05 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures.


C. Water-Reducing Admixture: ASTM C 494, Type A.

D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.

E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.

F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.5 CURING MATERIALS

A. Water: Potable.

B. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

C. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B.

2.6 RELATED MATERIALS


B. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class and grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.7 CONCRETE MIXES
A. Prepare design mixes, proportioned according to ACI 211.1 and ACI 301, for each type and strength of normal-weight concrete determined by either laboratory trial mixes or field experience.

B. Use a qualified independent testing agency for preparing and reporting proposed mix designs for the trial batch method.

1. Do not use Owner's field quality-control testing agency as the independent testing agency.

C. Proportion mixes to provide concrete with the following properties:

2. Maximum Water-Cementitious Materials Ratio: 0.50.
   a. Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8 inches after adding admixture to plant- or site-verified, 2- to 3-inch slump.

D. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6 percent plus or minus 1 percent.

E. Synthetic Fiber: Uniformly disperse in concrete mix at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd..

2.8 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with requirements and with ASTM C 94 and ASTM C 1116.

1. When air temperature is between 85 deg F and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.
2. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification
PART 3 - EXECUTION

3.1 PREPARATION

A. Proof-roll prepared base course surface to check for unstable areas and verify need for additional compaction. Proceed with pavement only after nonconforming conditions have been corrected and base course is ready to receive pavement.

B. Remove loose material from compacted base surface immediately before placing concrete.

3.2 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form release agent to ensure separation from concrete without damage.

3.3 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating reinforcement and with recommendations in CRSI's "Placing Reinforcing Bars" for placing and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh,
and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

### 3.4 JOINTS

A. General: Construct construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

1. When joining existing pavement, place transverse joints to align with previously placed joints.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour, unless pavement terminates at isolation joints.

1. Provide preformed galvanized steel or plastic keyway-section forms or bulkhead forms with keys, unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
2. Continue reinforcement across construction joints, unless otherwise indicated. Do not continue reinforcement through sides of pavement strips, unless otherwise indicated.
3. Use epoxy bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

1. Locate expansion joints at intervals of 50 feet, unless otherwise indicated.
2. Extend joint fillers full width and depth of joint.
3. Terminate joint filler less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.

5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.

6. Protect top edge of joint filler during concrete placement with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt-coat one-half of dowel length to prevent concrete bonding to one side of joint.

E. Control Joints: Form control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of the concrete thickness, as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint with groover tool to the following radius. Repeat grooving of control joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
   

2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random control cracks.

F. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to the following radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

   1. Radius: 1/4 inch.
3.5 **CONCRETE PLACEMENT**

A. Inspection: Before placing concrete, inspect and complete formwork installation, reinforcement steel, and items to be embedded or cast in. Notify other trades to permit installation of their work.

B. Remove snow, ice, or frost from base course surface and reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten base course to provide a uniform dampened condition at the time concrete is placed. Do not place concrete around manholes or other structures until they are at the required finish elevation and alignment.

D. Comply with requirements and with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery, at Project site, or during placement.

F. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

G. Consolidate concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures to consolidate concrete according to recommendations in ACI 309R.

1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand-spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and joint devices.

H. Screed pavement surfaces with a straightedge and strike off. Commence initial floating using bull floats or darbies to form an open textured and uniform surface plane.
before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading dry-shake surface treatments.

I. Curbs and Gutters: When automatic machine placement is used for curb and gutter placement, submit revised mix design and laboratory test results that meet or exceed requirements. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing as specified for formed concrete. If results are not approved, remove and replace with formed concrete.

J. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators, unless otherwise specified and approved in mix designs.

K. Hot-Weather Placement: Place concrete according to recommendations in ACI 305R and as follows when hot-weather conditions exist:

1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover reinforcement steel with water-soaked burlap so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, reinforcement steel, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.6 CONCRETE FINISHING

A. General: Wetting of concrete surfaces during screeding, initial floating, or finishing operations is prohibited.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and the concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots, and fill low spots. Refloat surface immediately to uniform granular texture.

1. Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.

3.7 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and follow recommendations in ACI 305R for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing,
screeding, and bull floating or darbying concrete, but before float finishing.

C. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.

D. Curing Methods: Cure concrete by moisture curing, curing compound, or a combination of these as follows:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with water.
2. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.8 PAVEMENT TOLERANCES

A. Comply with tolerances of ACI 117 and as follows:

1. Elevation: 1/4 inch.
3. Surface: Gap below 10-foot-long, unleveled straightedge not to exceed 1/4 inch.
5. Joint Width: Plus 1/8 inch, no minus.

3.9 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspection agency to sample materials, perform tests, and submit test reports during concrete placement. Sampling and testing for quality control may include those specified in this Article.

B. Testing Services: Testing shall be performed according to the following requirements:

1. Sampling Fresh Concrete: Representative samples of fresh concrete shall be obtained according to
2. Slump: ASTM C 143; one test at point of placement for each truckload. Additional tests will be required when concrete consistency changes.

3. Air Content: ASTM C 231, pressure method; one test for each compressive-strength test, but not less than one test for each day's pour of each type of air-entrained concrete.

4. Concrete Temperature: ASTM C 1064; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each set of compressive-strength specimens.

5. Compression Test Specimens: ASTM C 31; one set of four standard cylinders for each compressive-strength test. Cylinders shall be molded and stored for laboratory-cured test specimens unless field-cured test specimens are required.

6. Compressive-Strength Tests: ASTM C 39; one set for each day's pour of each concrete class exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd.. One specimen shall be tested at 7 days and two specimens at 28 days; one specimen shall be retained in reserve for later testing if required.

7. When frequency of testing will provide fewer than five compressive-strength tests for a given class of concrete, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

8. When total quantity of a given class of concrete is less than 50 cu. yd., Architect may waive compressive-strength testing if adequate evidence of satisfactory strength is provided.

9. Strength level of concrete will be considered satisfactory if averages of sets of three consecutive compressive-strength test results equal or exceed specified compressive strength and no individual compressive-strength test result falls below specified compressive strength by more than 500 psi.
C. Test results shall be reported in writing to Architect, General Contractor, concrete manufacturer, and Installing Contractor within 24 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing agency, concrete type and class, location of concrete batch in pavement, design compressive strength at 28 days, concrete mix proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

D. Additional Tests: Testing agency shall make additional tests of the concrete when test results indicate slump, air entrainment, concrete strengths, or other requirements have not been met, as directed by Architect. Testing agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42, or by other methods as directed.

3.10 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective, or does not meet requirements in this Section.

B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.
END OF SECTION 02751
SECTION 02760 – PAVEMENT MARKINGS

PART 1 – GENERAL

1.1 SECTION INCLUDES

Furnishing and applying permanent pavement markings.

1.2 DESCRIPTION

A. Provide all materials, labor, equipment, and services necessary to complete all traffic lane and parking lot striping as indicated in the Construction Documents.

B. Work includes, but not limited to painting of letters, markings, stripes on the pavement surface applied in accordance with this Section and at the locations shown on the Plans or as directed by the Architect/Engineer.

1.3 QUALITY ASSURANCE

A. All work under this section shall be performed in accordance with the current 2012 MDOT Standard Specifications for Construction, unless otherwise indicated on the drawings.

B. All physically handicapped / barrier free markings shall be in accordance with current ADA requirements and the current Michigan Barrier Free Graphics Design Manual.

C. Each paint container shall be clearly marked showing the name and address of manufacturer, description of material, date of packaging, and volume and weight of contents.

D. Use only personnel completely trained and experienced in installation of materials and equipment.
1.4 SUBMITTALS

A. Manufacturer's literature: Submit descriptive product data of materials, installation methods and procedures.

B. Certification of compliance: Furnish a certification from manufacturer that material for this project has been sampled, tested and complies with requirements of specifications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. The paint shall meet the specifications set forth in Section 920 of the 2012 MDOT Standard Specifications for Construction, unless otherwise indicated on the drawings.

B. Color shall be as Specified on the Plans or as follows:

<table>
<thead>
<tr>
<th>Stripping Item</th>
<th>Color</th>
<th>Stripe Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stop Bars</td>
<td>White</td>
<td>12”</td>
</tr>
<tr>
<td>Traffic Lanes</td>
<td>Yellow</td>
<td>4”</td>
</tr>
<tr>
<td>Bus Lanes</td>
<td>White</td>
<td>4”</td>
</tr>
<tr>
<td>Standard Parking Stalls</td>
<td>Yellow</td>
<td>4”</td>
</tr>
<tr>
<td>Barrier Free Parking Stalls</td>
<td>Blue</td>
<td>4”</td>
</tr>
<tr>
<td>No Parking Areas</td>
<td>Yellow</td>
<td>6”</td>
</tr>
<tr>
<td>Barrier Free Access Areas</td>
<td>Blue</td>
<td>4”</td>
</tr>
<tr>
<td>Curbs</td>
<td>As Noted</td>
<td>Paint Face on Plans of Curb</td>
</tr>
</tbody>
</table>

PART 3 - EXECUTION

3.1 WEATHER LIMITATIONS

A. The painting shall be performed only when the existing surface is dry and clean, when the minimum atmospheric temperature is in accordance with Table 811-2 of the 2012 MDOT Standard Specifications for Construction, and when the weather is not excessively windy, dusty or foggy.
3.2 EQUIPMENT

A. All equipment for the Work shall be approved by the General Contractor and shall include the apparatus necessary to properly clean the existing surface, a mechanical marking machine, and such auxiliary hand painting equipment as may be necessary to satisfactorily complete the job.

B. The mechanical marker shall be an approved self-propelled marking machine suitable for application of traffic paint. It shall produce an even and uniform film thickness at the required coverage and shall be designed so as to apply markings of uniform cross-sections and clear-cut edges without running or spattering and within the limits for straightness set forth herein.

C. Suitable adjustments shall be provided on the sprayer/sprayers of a single machine or by furnishing additional equipment for painting the width required.

3.3 PREPARATION OF EXISTING SURFACE

A. Immediately before application of the paint, the existing surface shall be cleaned, dry and entirely free from dirt, grease, oil, acids, laitance, or other foreign matter which could reduce the bond between the coat of paint and the pavement. Areas which cannot be satisfactorily cleaned by brooming and blowing shall be scrubbed as directed with a water solution of tri-sodium phosphate or an approved equal solution. After scrubbing, the solution shall be rinsed off and the surface dried prior to painting.

B. Existing markings or stripes, which are to be abandoned or removed, shall be obliterated or obscured by the best methods suited for the purpose and to the satisfaction of the Owner.
3.4 LAYOUTS AND ALIGNMENT

A. The Contractor is responsible for laying out proposed striping, which is to be approved by the Owner, before the Contractor is to proceed with the striping procedure. The Contractor is to insure that all subsequent striping meets the quality of the approved application.

B. On those sections of pavements where no previously applied figures, markings, or stripes are available to serve as a guide, suitable layouts and lines of proposed stripes shall be spotted in advance of the paint application. Control points shall be spaced at such intervals as will ensure accurate location of all markings.

C. The Contractor shall provide an experienced Technician to supervise the location, alignment, layout, dimensions and application of the paint.

3.5 APPLICATION

A. Markings shall be applied at the locations and to the dimensions and spacing indicated on the Plans or as specified. Paint shall not be applied until the indicated alignment is laid out and the conditions of the existing surface have been approved by the Owner.

B. The paint shall be mixed in accordance with the manufacturer's instructions before application. The paint shall be thoroughly mixed and applied to the surface of the pavement with the marking machine at its original consistency without the addition of thinner. If the paint is applied by brush, the surface shall receive two (2) coats; the first coat shall be thoroughly dry before the second coat is applied.

C. Prior to marking of the pavement, fourteen (14) days shall elapse from the application of the bituminous seal coat, slurry seal or the placement of the HMA surface course.
D. In the application of straight stripes, any deviation in the edges exceeding 1/2-inch in 50-feet shall be obliterated and the marking corrected. The width of the markings shall be as designated within a tolerance of 5 percent (5%).

3.6 PROTECTION

A. After applications of the paint, all markings shall be protected while the paint is drying. The fresh paint shall be protected from injury or damage of any kind. The Contractor shall be directly responsible and shall erect or place suitable warning signs, flags, or barricades, protective screens or coverings as required. Markings defaced by traffic or pedestrians shall be reinstalled at the contractor’s expense.
PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to the Bidding and Contract Requirements and General and Supplemental Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. Furnish all labor, materials, supplies, equipment, tools, and transportation, and perform all operations in connection with and reasonably incidental to the complete installation of the irrigation system, and guarantee/warranty as shown on the drawings, the installation details, and as specified herein. The system shall be constructed to grades and conform to areas and locations as shown on the drawings. Removal and or restoration of existing improvements, excavation and back-fill, and all other work in accordance with plans and specifications are required.

B. Extent of irrigation system work is shown on drawings and by provisions of this Section.

C. Sprinkler lines shown on the drawings are essentially diagrammatic. Spacing of the sprinkler heads or quick coupling valves are shown on the drawings and shall be exceeded only with the permission of the Owner’s authorized representative.

D. Items of Work Specifically Included Are:

1. Procurement of all applicable licenses, permits, and fees.
2. Coordination of all utilities.
3. Connection of electrical power supply to the irrigation control system.
5. Slewing for irrigation pipe and wire.

E. Related Work Specified Elsewhere:
   1. Section 02480: Landscape Work
   2. Section 02499: Landscape Maintenance and Warranty Standards

1.03 QUALITY ASSURANCE:

A. The Contractor shall maintain continuously a competent superintendent, satisfactory to the Owner, with authority to act for him in all matters pertaining to the work.

B. The Contractor shall coordinate his work with the other trades

C. The Contractor shall confine his operations to the area to be improved and to the areas allotted him by the Owner’s for material and equipment storage.

D. The Contractor shall have a minimum of 5 years experience installing irrigation systems of comparable size and complexity.

1.04 SUBMITTALS:

A. Submit samples under provisions of Section 01330 - Submittals.

B. Materials List: Include backflow device, valves, sprinklers, controller, wire, wire connectors, pipe, and fittings to be used on the project prior to purchasing materials. Quantities of material need not be included.

C. Manufacturer’s Data: Submit manufacturer’s catalog cuts, specifications, and operating instructions for equipment shown on the materials list.
D. Shop Drawings: Upon irrigation system acceptance, submit written operating and maintenance instructions. Provide format and contents as directed by the Architect. Include instruction sheets and parts lists for all operating equipment.

E. Project Record (As-Built) Drawings:

1. Submit record drawings under provisions of Section 01700 – Contract Closeout, Record Documents.
2. Record pipe and wiring network alterations. Record work that is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each controller or control unit, each sleeve end, each stub-out for future pipe or wiring connections, and other irrigation components enclosed within a valve box.
3. Before construction completion, obtain from the Engineer/Architect/Owner’s a digital copy of the drawings. Using CAD, duplicate information contained on the project drawings maintained on site. Label each sheet “Record Drawings”. Completion of the record drawings will be a prerequisite for the review at the completion of the irrigation system installation.

1.05 RULES AND REGULATIONS:

A. Work and materials shall be in accordance with the latest edition of the Michigan Electrical Code (2008 NEC with Part 8 Technical Amendments), 2009 Michigan Plumbing Code, the Uniform Plumbing Code as published
by the International Association of Plumbing and Mechanics Officials (IAPMO), and applicable laws and regulations of the governing authorities.

B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.

C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the “Contractor’s” responsibility to determine the actual quantities of all material, equipment, and supplies required by the project and to complete an independent estimate of quantities and wastage.

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, either threaded or plain.

C. Store and handle materials to prevent damage 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 CODES AND STANDARDS:

A. The entire installation shall fully comply with all local and state laws and ordinances and with all established codes applicable thereto.
B. Any permits for the installation or construction of the work included under this contract which are required by any of the legally constituted authorities having jurisdiction, shall be obtained and paid for by the Contractor, each at the proper time. He shall also arrange for and pay all costs concerning any inspections and examinations required by these authorities.

C. In all cases where inspection of the sprinkler system work is required and/or where portions of the work are specified to be performed under the direction and/or inspection of the Owner’s authorized testing agency, the Contractor shall notify the Owner’s authorized testing agency and Construction Manager at least 24 hours in advance of the time and such inspection and/or direction is required.

D. Any necessary re-excavation or alterations to the system needed because of failure of the Contractor to have the required inspections shall be performed at the “Contractor’s” own expense.

1.08 TESTING:

A. Notify the Engineer/Architect/Owner’s testing agency and Construction Manager three days in advance of testing.

B. Pipelines jointed with rubber gaskets or threaded connections may be subjected to a pressure test at any time after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints shall be allowed to cure at least 24 hours before testing.

C. Subsections of mainline pipe may be tested independently, subject to the review of the Engineer/Architect/Owner’s.

D. Furnish clean, clear water, pumps, labor, fittings, and equipment necessary to conduct tests or retests.
E. Volumetric Leakage Test:

2. Purge all air from the pipeline before test.
3. Subject mainline pipe to the anticipated operating pressure of 100 PSI for two hours.
4. Maintain constant pressure. The amount of additional water pumped in during the test shall not exceed 1.24 gallon per 100 joints of 3-inch diameter pipe and 1.6 gallons per 100 joint of 4-inch diameter pipe. Replace defective pipe, fitting, joint, valve, or appurtenance. Repeat the test until the pipe passes test.

a. Cement or caulking to seal leaks is prohibited.

F. Operational Test:

1. Activate each remote control valve in sequence from controller. The Engineer/Architect/Owner’s testing agency will visually observe operation, water application patterns, and leakage.
2. Replace defective remote control valve, solenoid, wiring, or appurtenance to correct operational deficiencies.
3. Replace, adjust, or move water emission devices to correct operational or coverage deficiencies.
4. Replace defective pipe, fitting, joint, valve, sprinkler, or appurtenance to correct leakage problems. Cement or caulking to seal leaks is prohibited.
5. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components, and correct deficiencies at no additional cost to the Owner.

1.09 CONSTRUCTION REVIEW:
A. The purpose of on-site reviews by the Engineer/Architect/Owner’s is to periodically observe the work in progress, the “Contractor’s” interpretation of the construction documents, and to address questions with regard to the installation.

B. Scheduled reviews such as those for irrigation system layout or testing must be scheduled with the Engineer/Architect’s/Owner’s as required by these specifications.

C. Impromptu reviews may occur at any time during the project.

D. A review will occur at the completion of the irrigation system installation and project record (as-built) drawing submittal.

E. It shall be the “Contractor’s” responsibility to ensure and guarantee satisfactory operation of the entire system and the workmanship and restoration of the area. The entire system shall be guaranteed to be complete and perfect in every detail for a period of one year from the date of its acceptance and he hereby agrees to repair or replace any such defects occurring within that year, free of expense to the Owner.

F. Minor maintenance and adjustment shall be by the Owner.

G. For a period of one year from commencement of the formal maintenance period, fill and repair depressions or settling more than one-quarter (¼”). Restore landscape or structural features damaged by the settlement of irrigation trenches or excavation.
Repair damage to the premises caused by a defective item.

H. Make repairs with in seven (7) days of notification from the Engineer/Architect/Owner’s.

I. Contract documents govern replacements identically as with new work. Make replacements at no additional cost to the contract price.

J. Guarantee/warranty applies to originally installed materials, equipment, and replacements made during the guarantee/warranty period.

1.10 WINTERIZATION AND SPRING START-UP:

A. Coordinate the winterization and start-up with the landscape maintenance personal.

B. Contractor shall winterize the system the first year as part of this contract, and will provide written instructions to the Owner for future service and maintenance.

C. 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 any damage caused in improper winterization at no additional cost to the Owner.

D. After completion, testing and acceptance of the system, the Contractor will instruct the Owner’s personnel in the operation and maintenance of the system.

PART TWO – MATERIALS
2.01 GENERAL:

A. Use materials that are new and without flaws or defects of any type, and which are the best of their class and kind. All material overages at the completion of the installation are the property of the Contractor and are to be removed from the site.

2.02 SUBSTITUTIONS:

A. The Contractor shall use materials as specified. Material other than specified will be permitted only after written application by the Contractor and written approval by the Architect. Substitutions will only be allowed when in the best interest of the Owner.

2.03 SLEEVING:

A. Install separate sleeve beneath paved areas to route each run of irrigation pipe or wiring bundle.

B. Sleeving material beneath pedestrian pavements shall be PVC Class 160 pipe with solvent welded joints.

C. Sleeving beneath drives and streets shall be PVC Class 160 pipe with solvent welded joints.

D. Sleeving diameter: equal to twice that of the pipe or wiring bundle.

2.04 PIPE AND FITTINGS:

A. Mainline Pipe and Fittings:

1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the
requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D-1784, with an integral belled end.

2. Use Class 160, SDR-26, rated at 160 PSI, conforming to the dimensions and tolerances established by ASTM Standard D-2241. Use PVC pipe rated at higher pressures than Class 160 in the case of small nominal diameters that are not manufactured in Class 160.

3. Use rubber-gasketed pipe equipped with Reiber Gasket System for mainline pipe with a nominal diameter greater than 3-inches. Use rubber-gasketed deep bell ductile iron fitting conforming to ASTM A-536 and ASTM F-477. Use lubricant approved by the pipe manufacturer. Size slip fitting socket taper to permit a dry un-softened pipe end to be inserted no more than halfway into the socket. Saddle and cross fittings are not permitted. Use male adapters for plastic to metal connections. Hand Tighten male adapters plus one turn with a strap wrench.

4. Use solvent weld pipe for mainline pipe with a nominal diameter less than or equal to 3-inches or where a pipe connection occurs in a sleeve. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standard D-2466 and D 1784. Use primer approved by the pipe manufacturer. Solvent cement to conform to ASTM Standard D-2564.

5. Provide pipe homogeneous throughout and free from visible cracks, holes, foreign materials, blisters, wrinkles and dents.

6. Provide pipe continuously and permanently marked with manufacturer’s name or trademark, size schedule and type of pipe working pressure at 73 degrees F. and (NSF) approval.

7. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the Contractor.

8. All pipes damaged or rejected because of defects shall be removed from the site at the time of said rejection.
B. Lateral Pipe and Fitting:

1. All sprinkler laterals pipe downstream from the zone valves, sized 2" and smaller shall be flexible non-toxic polyethylene (PE) pipe. Use SDR-11.5, PE23, rated at PSI that is National Sanitation Foundation (NSF) approved, conforming to ASTM Standard D-2239. Use Type 1, PVC insert fitting conforming to ASTM Standard D-2609 designed for use with flexible polyethylene (PE) pipe. Use stainless steel worm gear clamps (including stainless steel screw) to join pipe and fittings. Pipe larger than 2" shall be rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-B, ASTM Standard D-1784, with an integral belled end suitable for solvent welding.

2. Use Class 160, SDR-26, rated at 160 PSI, conforming to the dimensions and tolerances established by ASTM Standard D-2241. Use solvent weld pipe for lateral pipe. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D-2466 and D-1784 for PVC pipe. Use primer approved by the pipe manufacturer and purple in color. Solvent cement to conform to ASTM Standard D-2564, of a type approved by the pipe manufacturer appropriate to weather conditions.

3. For drip irrigation laterals downstream of zone control valves, use UV radiation-resistant polyethylene pipe manufactured from prime Union Carbide or a Union Carbide licensee with a minimum of 2% carbon black. Use PVC/compression line fittings compatible with the drip lateral pipe. Use tubing stakes or landscape fabric staples to hold aboveground pipe in place.

C. Specialized Pipe and Fittings:
1. All above grade pipe shall be copper pipe: Use Type “M” rigid conforming to ASTM Standard B-88. Use wrought copper or cast bronze fitting, soldered or threaded per the installation details. Use 95% tin and 5% antimony solder.


3. Ductile iron pipe: Use Class 50 conforming to ANSI A21.51. Use a minimum of Class 53 thickness pipe for flanged piping. Use mechanical joints conforming to ANSI A21.10 and ANSI A21.11 (AWWA C111) or flanged fittings conforming to ANSI/AWWA C110 and ANSI B16.1 (125#).

4. Use a dielectric union wherever a copper-based metal (copper, brass, and bronze) is joined to an iron-based metal (iron, galvanized steel, and stainless steel).

5. Low-Density Polyethylene Hose:
   a. Use pipe specifically intended for use as a flexible swing joint.
      Inside diameter: 0.490 ± 0.010 inch.
      Wall thickness: 0.100 ± 0.010 inch.
      Color: Black
   b. Use spiral barb fittings supplied by the same manufacturer as the hose.

6. Assemblies calling for threaded pipe connections shall use PVC Schedule 80 nipples and PVC Schedule 40 threaded fittings.

7. Joint sealant: Use only Teflon-type tape or Teflon-based paste pipe joint sealant on plastic threads. Use non-hardening, nontoxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

D. Thrust Blocks:
1. Use thrust blocks for fitting on pipe greater than or equal to 3-inch diameter or any diameter rubber gasket pipe.
2. Use 3,000-PSI concrete.
3. Use 2-mil plastic.
4. Use No. 4 re-bars wrapped or painted with asphalt tar based mastic coating.

2.05 MAINLINE COMPONENTS:

A. Main System Shutoff Valve: per local practice and in compliance with local code.

B. Winterization Assembly: per local practice and in compliance with the local code.

C. Backflow Prevention Assembly: as presented in the installation details.

D. Isolation Gate Valve Assembly: as presented in the installation details. Install a separate valve box over a 3-inch depth of ¾-inch gravel for each assembly.

E. Quick Coupling Valve Assembly: double swing joint arrangements as presented in the installation details.

2.06 SPRINKLER AND BUBBLER IRRIGATION COMPONENTS:

A. Remote Control Valve (RCV) Assembly for Sprinkler and Bubbler Laterals: as presented in the installation details. Use 3M DBY wire connectors to join control wires to solenoid valves. Install a separate valve box over a 3” depth of ¾” gravel for each assembly.

B. Sprinkler Assembly: as presented in the drawings and installation details. When required use the sprinkler manufacturer’s pressure compensating screens (ex. Rain Bird PCS) to achieve 30 PSI operating conditions on each sprinkler and to control excessive operating pressures.
C. Bubbler Assembly: As presented in the drawings and installation details.

2.07 CONTROL SYSTEM COMPONENTS:

A. Irrigation Controller Unit:

1. As presented in the drawing and installation details.

2. Lighting Protection: Provide 8-foot copper-clad grounding rod at controller location (when specified).

3. Wire Markers: Pre-numbered or labeled with indelible non-fading ink, made of permanent, non-fading material.

B. Control Wire:

1. Use American Wire Gage (AWG) No. 14 solid copper, Type UF or PE cable, UL approved for direct underground burial from the controller unit to each remote valve.

2. Color: Use white for common ground wire. Use red colors for control wires. Spare control wires shall be marked or labeled different from that of the active control wire. Wire color shall be continuous over its entire length.


C. Instrumentation:

1. As presented in the drawing and installation details.

2. When required provide, install and test an anemometer for irrigation shutdowns at user-present wind velocity thresholds, soil moisture monitoring to override irrigation in the event of high soil moisture levels, and a temperature
sensor to prevent irrigation when temperatures drop below a user-preset threshold.
3. Provide a rain sensor to prevent irrigation during or immediately after rainfall events.

D. Power Wire:

1. Electric wire from the power source to satellite control unit shall be solid or stranded copper, Type UF single-conductor cable, UL approved for direct underground burial. Power wires shall be black, white, and green in color. Size as presented in the drawings. The Contractor is responsible for verifying that the power wire sizes shown on the drawings are compatible and adequate for the control system being used.

2.08 OTHER COMPONENTS:

A. Tools and Spare Parts: Provide operating keys, servicing tools, test equipment, spare parts, and other items indicated in the general notes of the drawings.

B. Other Materials: Provide imported fill material as required to complete this work. Provide other materials or equipment shown on the drawings or installation details, which are part of the irrigation system, although such items may not have been referenced in these specifications.

PART THREE - EXECUTION

3.01 INSPECTION AND REVIEWS:
A. Site Inspections:

1. The bidder acknowledges that he has examined the site, plans and specifications, and the submission of a proposal shall be considered evidence that examination has been made.

2. Verify construction site conditions and note irregularities affecting work of this section. It shall be the contracting installer’s responsibility to report in writing to the Construction Manager any deviations between drawings, specifications and the site. Failure to do so before the installing of equipment and resulting in replacing and/or relocation of equipment shall be done at the “Contractor’s” expense.

3. Examine final grades and installation conditions. Do not start irrigation system work until unsatisfactory conditions are corrected.

4. Beginning work of this section implies acceptance of existing conditions.

B. Utility Locations:

1. The exact location of all existing utilities and structures and underground utilities are not indicated on the drawings; their locations shall be determined by the Contractor, and he shall conduct his work so as to prevent interruption of service or damage to them.

2. Arrange for and coordinate with local authorities the location of all underground utilities.

3. Repair any underground utilities damaged during construction. Make repairs at no additional cost above the contract price.

4. The Contractor shall protect existing structures and utility services and be responsible for their replacement if damaged by him.
C. Irrigation System Layout Review:

1. Irrigation system layout review will occur after the staking has been completed unless specifically waived by the Architect. Notify the Engineer/Architect/Construction Manager one-week in advance of review.

2. The Engineer/Architect/Construction Manager at this review will identify modifications.

3.02 LAYOUT OF WORK:

A. Stake out the irrigation system. Items staked include: sprinklers, pipe, control valves, manual drains, quick coupling valves, backflow preventer, controller, and isolation valves.

B. Install all mainline pipe and mainline components inside of project property lines.

C. Minor adjustments in system layout will be permitted to clear existing fixed obstructions. Final system layout shall be acceptable to the Architect.

3.03 EXCAVATION, TRENCHING, AND BACKFILLING:

A. Excavating shall be considered unclassified and shall include all materials encountered, except materials that cannot be excavated by normal mechanical means.

B. Excavate to permit the pipes to be laid at the intended elevations and to permit work space for installing connections and fittings.

C. Minimum cover (distance from top of pipe or control wire to finish grade):
1. 14-inch over mainline pipe and over electrical conduit.
2. 16-inch over control wire.
3. 10-inch over lateral pipe to sprinklers and bubblers and over manifold pipe to drip system zone control valves.
4. 8-inch over drip in turf or paved areas downstream of drip system zone control valves.
5. 3-inch minimum mulch cover over drip lateral pipe in planting beds downstream of drip system zone control valves.
6. PVC UV radiation-resistant lateral pipe shall be installed directly on the soil surface.

D. PVC or PE lateral pipes may be pulled into the soil using a vibratory plow device specifically manufactured for pipe pulling. Minimum burial depths equals minimum cover listed above provided soil moisture content and other conditions are suitable to allow for full depth of bury with a minimum of stretching and scraping of the pipe. Architect reserves the right to determine suitability or conditions.

E. Backfill only after lines have been reviewed and tested.

F. Excavated material is generally satisfactory for backfill. Backfill shall be free from rubbish, vegetable matter, and stones larger than 2 inches in maximum dimension. Remove material not suitable for backfill. Backfill placed next to pipe shall be free of sharp objects, which may damage the pipe.

G. Backfill unsleeved pipe by depositing the backfill material equally on both sides of the pipe in 6-inch layers and compacting each layer to 90% Standard Proctor Density, ASTM D-698-78. Use of water for compaction, “puddling,” will not be permitted.

I. Dress backfilled areas to original grade. Incorporate excess backfill into existing site grades.

J. Where utilities conflict with irrigation trenching and pipe work, contact the Engineer/Architect/Construction Manager for trench depth adjustments.

K. Provide approved fine-grained earth fill or sand to point 4” above the top of pipe, where soil conditions are rocky or otherwise objectionable.

L. Excavate trenches and install piping and backfill during the same working day. Do not leave open trenches or partially filled trenches open overnight.

3.04 SLEEVING AND BORING:

A. Install sleeving at a depth that permits the encased pipe or wiring to remain at the specified burial depth.

B. Extend sleeve ends six inches beyond the edge of the paved surface. Cover pipe ends and mark with stakes. Mark concrete with a chiseled “X” at sleeve end and locations.

C. Bore for sleeves under obstructions that cannot be removed. Employ equipment and methods designed for horizontal boring.

3.05 ASSEMBLING PIPE AND FITTING:
A. General:

2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
3. All mainline and continuously pressurized pipe is to be installed using open trenches. Lateral pipe may be installed be "Plowing" if soil conditions permit, and soils do not contain gravel, rock, construction debris, or other potential damaging material.
4. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radii of curvature are 25 feet for 2-inches diameter pipe and 100 feet for 2 ½, 3, and 4-inch diameter pipe. All curvature results from the bending of the pipe lengths. No deflection will be allowed at a pipe joint.

B. Mainline and Fittings:

1. Use only strap-type friction wrenches for threaded plastic pipe.
2. PVC Rubber-Gasketed Pipe:
   a. Use pipe lubricant. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
   b. Epoxy-coated steel fittings shall not be struck with a metallic tool. Cushion blows with a wood block or similar shock absorber.

3. PVC Solvent Weld Pipe:
a. Use a primer and solvent cement. Join pipe in a manner recommended by the manufacturer and in accordance with accepted industry practices.
b. Cure for 30 minutes before handling and 24 hours before allowing water in pipe.
c. Snake pipe from side to side within the trench.

4. Fittings: the uses of cross type fittings or saddle-tees are not permitted.

5. Install thrust blocks on the mainline pipe work in accordance with pipe manufacturer’s written instructions.

C. Lateral Pipe and Fittings:

1. Use only strap-type friction wrenches for threaded plastic pipe.

2. PVC Solvent Weld Pipe:

   a. Use primer and solvent cement. Join pipe in the manner recommended by the manufacturer and in accordance with accepted industry practices.
   b. Cure for 30 minutes before handling and 24 hours before allowing water in the pipe.
   c. Snake pipe from side to side within the trench.

3. Polyethylene (PE) Pipe:

   a. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
   b. Snake pipe from side to side within the trench.
   c. Double clamp pipe 1-1/2” diameter and larger.

4. UV Radiation-Resistant Polyethylene Pipe:
a. Join pipe in the manner recommended by the manufacturer and in accordance with accepted industry practices.

b. Snake pipe side to side within the trench, on the soil surface, and hold in place with the tubing stakes or landscape fabric staples spaced every five feet. Pipe is not too compressed or crimped by the stake or staple or other construction activity.

5. Fittings: The use of cross types fittings and/or saddle tees are not permitted.

D. Specialized Pipe and Fitting:

1. Copper Pipe:
   a. Buff surface to be joined to a bright finish. Coat with solder flux.
   b. Solder so that a continuous bead shows around the joint circumference.

2. Galvanized Steel Pipe:
   a. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
   b. Use factory-made threads whenever possible. Field-cut threads will be permitted only where necessary. Cut threads on axis using clean, sharp dies.
   c. Apply Teflon-type tape or pipe joint compound to the male threads only.

3. Ductile Iron Pipe:
a. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.

b. Insert dielectric union wherever a copper-based metal (copper, brass, bronze) and an iron-based metal (iron, galvanized steel, and stainless steel) are joined.

4. Low-Density Polyethylene Hose: Install per manufacturer’s recommendations.

5. PVC Threaded Connections:

   a. Use only factory-formed threads. Field-cut threads are not permitted.

   b. Use only Teflon-type tape or Teflon-based paste.

6. Threaded Connections:

   a. When connection is plastic to metal, the plastic component shall have male threads and the metal component shall have female threads.

   b. Make metal-to-metal, threaded connections with Teflon-type tape or pipe joint compound applied to the male threads only.

E. Thrust Blocks:

1. Use cast-in-place concrete bearing against undisturbed soil.

2. Size, orientation, and placement shall be as shown on the installation details.

3. Wrap fitting with plastic to protect bolts, joint, and fitting from concrete.

4. Install re-bar with mastic coating as shown on the installation details.

3.06 INSTALLATION OF MAINLINE COMPONENTS:

A. Main System Shut Off Valve: Install where indicated on the drawing.
B. Winterization Assembly: Install where indicated on the drawing.

C. Backflow Prevention Assembly: Install where indicated on the drawing. Install assembly so that its elevation, orientation, access, and drainage conform to the manufacturer’s recommendations and all applicable health codes.

D. Quick Coupling Valve Assembly: Install where indicated on the drawings.

E. Manual Drain Valve Assembly: Install where indicated on the drawings and at other low points in the mainline piping.

3.07 INSTALLATION OF SPRINKLER AND IRRIGATION COMPONENTS:

A. Remote Control Valve (RCV) Assembly for Sprinkler and Bubbler Laterals:

1. Flush mainline before installation of RCV assembly.
2. Install where indicated on the drawing. Wire connectors and waterproof sealant shall be used to connect control wires to remote control valve wire. Install connectors and sealant per the manufacturer’s recommendations.
3. Install only one RCV to a valve box. Locate valve box at least 12 inches from and align with nearby walls and edges of paved areas. Group RCV assemblies together where practical. Arrange grouped valve boxes in rectangular patterns. Allow at least 12 inches between valve boxes.
4. Adjust RCV to regulate the downstream operating pressure.
5. Attach ID tag with controller station number to control wiring.

B. Sprinkler Assembly:
1. Flush lateral pipe before installing sprinkler assembly.
2. Install per the installation details at locations shown on the drawings.
3. Locate rotor sprinklers 6 inches from adjacent walls, fences, or edges of paved areas.
4. Locate spray sprinklers 3 inches from adjacent walls, fences, or edges of paved areas.
5. Install sprinklers perpendicular to the finish grade.
6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
7. Adjust the radius of throw of each sprinkler for best performance.

C. Bubbler Assembly:

1. Flush lateral pipe before installing bubbler assembly.
2. Install bubbler assembly per the installation details at locations shown on the drawings.
3. Adjust the output flow of each bubbler for performance.

3.08 INSTALLATION OF CONTROL SYSTEM COMPONENTS:

A. Irrigation Controller Unit:

1. The location of the collector unit as depicted on the drawings is approximate; the Engineer/Architect/Owner will determine the exact site location during sprinkler layout review.
2. Lighting protection: Drive 8-foot copper-clad grounding rod into the soil. If rock prevents driving, bury at least four feet deep. Use one rod for each controller. Connect controller to ground rod with AWG No. 10 solid conductor copper wire. Secure wire to grounding rod with brass or bronze clamp. Locate the connection in a separate valve box (when specified).
3. Attach wire markers to the ends of control wires inside the controller unit housing. Label wires with the identification numbers (see drawings) of the remote control valve to which the control wire is connected.

4. Install a 120-volt, 15-amp switched and grounded 3-prong receptacle with GFIC inside the controller unit housing.

5. Connect control wires to the corresponding controller terminal.

B. Control Wire:

1. Bundle control wires where two or more are in the same trench. Bundle with pipe wrapping tape at 10-foot intervals.

2. Control wiring may be chiseled into the soil using a vibratory plow device specifically manufactured for pie pulling and wire installation. Appropriate chisel must be used so that wire is fed into a chute on the chisel, and wire is not subject to pulling tension. Minimum burial depth must equal minimum cover previously listed.

3. Provide a 24-inch excess length of wire in an 8-inch diameter loop at each 90-degree change of direction, at both ends of sleeves and at 100-foot intervals along continuous runs of wiring. Do not tie wiring loop. Coil 24-inch length of wire within each remote control valve box.

4. Install common ground wire and one control wire for each remote control valve. Multiple valves on a single control wire are not permitted.

5. If a control wire must be spliced, make splice with wire connectors and waterproof sealant, installed per the manufacturer’s instructions. Locate splice in a valve box that contains an irrigation valve assembly, or in a separate 6-inch round valve box.

6. Use same procedure for connection to valves as for in-line splices.

7. Unless noted on plans, install wire parallel with and below PVC mainline pipe.
8. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill six inches above the wiring.

C. Instrumentation:

1. Install sensor per the installation details and manufacturer’s recommendations. Install at locations shown on the drawings.
2. Install electrical connections between central control unit components and sensors per manufacturer’s recommendations.

D. Power Wire:

1. Route power wire as directed on plans. Install with a minimum number of field splices. If a power wire must be spliced, make splice with recommended connector, installed per manufacturer’s recommendations. Locate all splices in a separate 10-inch round valve box. Coil 2 feet of wire in valve box.
2. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.
3. Green wire shall be used as the common ground wire from power source to all satellites.
4. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
5. Unless noted on plans, install wire parallel with and below mainline pipe. Install wire 2 inches below top of PVC mainline pipe.
6. Encase wire not installed with PVC mainline pipe in electrical conduit with a continuous run of warning tape placed in the backfill, 6 inches above wiring.

3.09 INSTALLATION OF OTHER COMPONENTS:

A. Tools and Spare Parts: Prior to the review at completion of construction, supply to the owner operating keys, servicing tools, spare parts, test
equipment, and any other items indicated in general notes on the drawings.

B. Other Materials: Install other materials or equipment shown on the drawings or installation details which are part of the irrigation system, even though such items may not have been referenced in these specifications.

3.10 MAINTENANCE:

A. Upon completion of construction and review by the Engineer/Architect/Construction Manager, maintain irrigation system for duration of 30 calendar days. Make periodic examinations and adjustments to irrigation system components to achieve the most desirable application of water.

B. Following completion of the “Contractor’s” maintenance period, the Owner will be responsible for maintaining the system in working order during the remainder of the guarantee/warranty period, for performing necessary minor maintenance, for trimming around sprinklers, for protecting against vandalism, and for preventing damage after the landscape maintenance operation.

3.11 CLEANUP:

A. Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.
PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this section.

B. All work to be performed under this Section shall be in accordance with, and by means and methods outlined in the Michigan Department of Transportation 2003 Standard Specifications for Construction, unless modified herein.

1.2 SUMMARY

A. Section Includes:
   1. Fence framework, fabric, and accessories.
   2. Excavation for post bases.
   3. Concrete foundation for posts and center drop for gates.

B. Related Sections:
   1. Section 02300 – Earthwork.
   2. Section 03001 – Concrete Work.

1.3 REFERENCES

A. ASTM International:
   3. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon,
Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.


B. Chain Link Fence Manufacturers Institute:
   1. CLFMI - Product Manual.

1.4 SYSTEM DESCRIPTION

A. Fence Height: 6 feet nominal unless indicated otherwise on the drawings.

B. Line Post Spacing: At intervals not exceeding 6 feet.

1.5 SUBMITTALS

A. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, gates, and schedule of components.

B. Product Data: Submit data on fabric, posts, accessories, fittings and hardware.

1.6 QUALITY ASSURANCE

A. Supply material in accordance with CLFMI - Product Manual.

B. Perform installation in accordance with ASTM F567.
C. Perform Work in accordance with Shelby Township requirements.

1.7 DELIVERY, STORAGE AND HANDLING

A. Protect materials from dirt and damage.
B. Deliver fence fabric and accessories in packed cartons or firmly tied rolls.
C. Identify each package with manufacturer’s name.
D. Store fence fabric and accessories in secure and dry place.

1.8 PROJECT CONDITIONS

A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
B. Existing utilities: Do not interrupt serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according the requirements indicated:
   1. Notify General Contractor and Owner not less than 72 hours in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without General Contractor and Owner’s written permission.

PART 2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. Materials and Components: Conform to CLFMI Product Manual.
C. Intermediate Posts: Type I round
D. Terminal, Corner, Rail, Brace, and Gate Posts: Type I round

2.2 MATERIALS

A. Framing (Steel): ASTM F1083 Schedule 40 galvanized steel pipe, welded construction, minimum yield strength of 50 ksi; coating conforming to ASTM F1043 Type A on pipe exterior and interior (Black Vinyl Coated)


C. Concrete: Type specified in Section 03001 – “Concrete Work”.

2.3 COMPONENTS

A. Line Posts: 3 inch diameter. (Black Vinyl Coated)

B. Corner and Terminal Posts: 4 inch diameter. (Black Vinyl Coated)

C. Gate Posts: 6-5/8 inch diameter. (Black Vinyl Coated)

D. Top, Bottom and Brace Rail (fencing) 1-5/8 inch diameter, plain end, sleeve coupled. (Black Vinyl Coated)

E. Gate Frame: 2 inch diameter for top and bottom rails, 1-5/8 inch diameter for cross members. (Black Vinyl Coated)

F. Fabric: 2 inch diamond mesh interwoven wire, 9 gage, top and bottom selvage knuckle end closed. (Black Vinyl Coated)

G. Tension Wire: 9 gage galvanized steel. (Black Vinyl Coated)

H. Tie Wire: Aluminum alloy steel wire. (Black Vinyl Coated)
2.4 ACCESSORIES

A. Caps: Galvanized pressed steel; sized to post diameter, set screw retainer. (Black Vinyl Coated)

B. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; galvanized steel. (Black Vinyl Coated)

C. Gate Hardware: 180 degree gate hinges for each leaf and hardware for padlock. (Black Vinyl Coated)

D. Padlock: Knox Padlock as manufactured by Knox Company.

2.5 GATES

A. General:
   1. Gate Types, Opening Widths and Directions of Operation: As indicated on Drawings.
   2. Factory assemble gates.
   3. Design gates for operation by one person.

B. Swing Gates:
   1. Fabricate gates to permit 180 degree swing.
   2. Gates Construction: ASTM F900 with welded corners. Use of corner fittings is not permitted.

2.6 FINISHES

A. Components and Fabric: Galvanized to ASTM A123/A123M for components; ASTM A153/A153M for hardware; ASTM A392 for fabric; 2.0 oz/sq. ft coating. (Black Vinyl Coated)

B. Hardware: Galvanized to ASTM A153/A153M, 2.0 oz/sq. ft coating. (Black Vinyl Coated)

C. Accessories: Same finish as framing. (Black Vinyl Coated)
PART 3 EXECUTION

3.1 INSTALLATION

A. Install framework, fabric, accessories and gates in accordance with ASTM F567.

B. Set intermediate, terminal and gate posts plumb, in concrete footings; placement and material requirements per Section 03001 - “Concrete Work”. Slope top of concrete for water runoff.

C. Corner, Terminal and Line Post Footing Depth Below Finish Grade: ASTM F567.

D. Gate Post Footing Depth Below Finish Grade: As shown on plans.

E. Brace each corner post to adjacent line post with horizontal center brace rail and diagonal truss rods. Install brace rail one bay from end and gate posts.

F. Install top rail through line post tops and splice with 6 inch long rail sleeves.

G. Place fabric on outside of posts and rails.

H. Stretch fabric between terminal posts or at intervals of 100 feet maximum, whichever is less.

I. Position bottom of fabric 1 inch above finished grade.

J. Fasten fabric to top rail, line posts, braces, and bottom tension wire with tie wire at maximum 15 inches on centers.

K. Attach fabric to end, corner, and gate posts with tension bars and tension bar clips.

L. Connect to existing fence at existing or new terminal post as required.
M. Excavate holes for posts to diameter and spacing indicated on Drawings without disturbing underlying materials.

N. Center and align posts. Place concrete around posts, and vibrate or tamp for consolidation. Verify vertical and top alignment of posts and make necessary corrections.

O. Allow footings to cure minimum 7 days before installing fabric and other materials attached to posts.

3.2 ERECTION TOLERANCES

A. Maximum Variation From Plumb: ¼ inch.

B. Maximum Offset From Indicated Position: 1 inch.

C. Minimum distance from property line: Match existing distance from property line, unless noted otherwise on the drawings.

END OF SECTION
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specifications sections, apply to work of this section.

1.02 SUMMARY:

A. All labor, material and equipment necessary for, and incidental to proper completion of all gates installation. Location and extent of gates is shown on drawing and includes gates for dumpster enclosure, and access where shown.

1.03 SUBMITTALS:

A. Submit manufacturer's product data for gate components.

B. Submit complete shop drawings for gates, and connections with descriptive data of installation methods and procedures.

C. Certificates: Manufacturer's certification that materials meet specification requirements.

D. Submit shop drawings and samples of all gates and components to Architect for approval prior to selecting manufacturer and/or installer.

E. Record Drawings: At project close out, submit record drawings of installed gates system, in accordance with requirements of Division 1.

1.04 WARRANTY:

A. All material and workmanship guaranteed against defects for two years from time of final acceptance. Contractor to remedy any unsatisfactory conditions during guarantee period at no cost to Owner.
PART 2 - PRODUCTS

2.01 MATERIALS/EQUIPMENT:

A. Manufacturers: All pipe, gate and fittings shall be American made.

B. Wood Screen:
   1. Provide 2 x 6 rough sawn cedar pressure treated wood slats at dumpster gate enclosure. Stain color to be selected by Architect.

2.02 POSTS AND FITTINGS:

A. Posts: Shall be heavy duty double galvanized steel pipe in sizes indicated in Drawings and conforming to Section 05500 “Metal Fabrications”.

B. Frame: Shall be double galvanized steel in sizes and configurations indicated in Drawings and conforming to Section 05500 “Metal Fabrications”.

2.03 FITTINGS:

A. All of heavy malleable iron or pressed steel, hot dipped galvanized.

2.04 FINISH:

A. All materials heavy hot dipped galvanized per ASTM.

2.05 CONCRETE:

A. Equivalent to ASTM C-94, ready-mixed concrete.

B. Minimum 28 days compression strength 4000 psi.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Verify that final grading around gate location is complete without irregularities which would interfere with gate installation.

B. Do not commence work until unsatisfactory conditions have been corrected.
3.02 PREPARATION:
   A. Measure parallel to surface of ground.
   B. Locate and mark position of posts.

3.03 INSTALLATION:
   A. Posts:
      1. Post hole diameter: 30" unless shown otherwise on drawing.
      2. Post hole depth: 48" unless shown otherwise on drawing.
      3. Set post plumb to 1/4" in 10'.
      4. Crown surface of concrete to slope away from post.
      5. The Contractor is responsible for all line and grade.

3.04 ADJUST AND CLEAN:
   A. Adjust brace rails and tension rods for rigid installation.
   B. Tighten hardware, fasteners and accessories.
   C. Remove excess and waste materials from project site.
   D. Restore topsoil to finished grade throughout gate installation area.
SECTION 02925 - CLEANUP AND RESTORATION

PART 1 - GENERAL

A. The Contractor shall restore areas disturbed by construction activities to a condition reasonably close to their condition before the project, unless shown otherwise on the plans. Restoration work should be performed as soon as possible after construction work is completed in a particular area.

B. Upon the completion of work in an area, all excess materials, debris, equipment, and similar items shall be removed from the project area by the Contractor, and disposed of properly.

PART 2 - MATERIALS

Not Applicable.

PART 3 - EXECUTION

3.01 Restoration

A. Unless otherwise provided; aggregate surfaces, bituminous pavements, and concrete pavements shall be restored by construction of similar replacement surfaces. Aggregate surfaces shall be replaced with the materials and thicknesses of similar replacement materials. Bituminous pavement shall be replaced with the cross sections(s) shown on the plans and in accordance with the specification for bituminous paving. Concrete pavement shall be replaced with pavement in accordance with the specification for Concrete Pavement.

B. Turf areas shall be restored by re-establishing the turf as described in the specification for landscape work. All areas disturbed by construction that are not to be surfaced with aggregate or pavement shall be restored with turf, unless otherwise directed.

C. Mailboxes, fences, signs, ornaments, and similar items shall be replaced at the completion of construction. Posts
shall be installed plumb. Items that are lost or stolen shall be repaired or replaced at the Contractor's expense. Repairs or replacements shall meet the Owner's approval.

3.02 Temporary Restoration of Driving Surfaces

A. Where a pavement or gravel surface is removed as a result of construction activities, a temporary surface shall be provided and maintained by the Contractor until the permanent surface is provided. Unless otherwise directed, the temporary surface shall be twelve inches of aggregate compacted to at least 95 percent of its maximum density (ASTM D1557) and graded to meet the adjacent, remaining surfaces. Aggregate shall meet the requirements of Series 23A as described in the 2013 Michigan Department of Transportation Specifications.

B. The Contractor shall regrade the temporary surface and add additional aggregate at intervals necessary to maintain them in a relatively smooth condition.

***END OF SECTION***
 SECTION 03001 – CONCRETE

PART 1. GENERAL

1.01 RELATED DOCUMENTS

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this specification.

1.02 SECTION INCLUDES

A. Work included in this section includes furnishing all labor, materials, equipment and incidentals required for complete installation of formwork, reinforcement, accessories, cast-in-place concrete, finishing and curing. This section pertains to building concrete work.

B. Related work specified elsewhere:

1. Section 03300 – Bonding Agents for Concrete
2. Section 05500 – Metal Fabrications

1.03 SUBMITTALS

A. Comply with ACI 315 “Details and Detailing of Concrete Reinforcement”. Indicate reinforcement sizes, spacings, locations, and quantities, bending and cutting schedules, supporting and spacing devices.

B. See Structural and/or Architectural drawings for General Notes and Special Conditions.

C. Provide data on joint devices, attachment accessories, mix design for each type concrete, proportions of all ingredients, admixtures, slump range, expected strength and water cement ratio. Provide historical test data with each proposed mix design.

1.04 QUALITY ASSURANCES

A. Building Code Requirements for Structural Concrete (ACI 318) and latest supplements thereto.

B. Standard Practice for Selecting Proportions for Normal, Heavy Weight, and Mass Concrete (ACI 211.1).

C. Hot Weather Concreting (ACI-305R).
D. Cold Weather Concreting (ACI-306R).

E. Guide for Measuring, Mixing, Transporting and Placing Concrete (ACI 304R).

F. Guide to Curing Concrete (ACI 308R).

G. Specifications for Structural Concrete (ACI 301).

H. Guide for Concrete Floor and Slab Construction (ACI 302.1R).

I. Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete (ASTM C618).

J. Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type) - (ASTM D994).

K. Guide to Formwork for Concrete (ACI 347).

L. Concrete Reinforcing Steel Institute (CRSI) "Manual of Standard Practice.

M. Design and workmanship of all concrete shall be in accordance with referenced specifications and code listed above. Quality, tolerances, and level of performance of work shall be as specified therein. Contractor shall keep on file, in project office, current copies of all references listed above.

PART 2. PRODUCTS

2.01 FORM MATERIALS

A. Form Material for Exposed Concrete: Plywood; 5/8" APA B-B plyform Class 1, exterior. Use plywood thickness sufficient to support concrete at temperature and rate of pour. Use only sound, undamaged sheets with clean, true edges. Furnish in largest sizes to minimize joints.

B. Form Material for Unexposed Concrete: Plywood; 5/8" APA B-B-G-2, exposure 1, exterior, plywood graded per PS-1 standards for construction and industrial plywood. Use plywood thickness sufficient to support concrete at temperature and rate of pour. Use only sound, undamaged sheets with clean, true edges. Lumber shall be standard grade or better.
C. In lieu of "A" above, the material specified under "B" may be used for exposed concrete if a 3/16" smooth one side, treated, pressed fiberboard liner is utilized.

D. Lumber for light framing (less than 6" wide): standard grade and species. Framing (6" wider and from 2" to 4" thick): provide No. 1 grade in one of the following species:
   1. Douglas Fir (WWPA).
   2. Southern Pine (SPIB).
   3. Redwood (RIS).

E. Prefabricated steel or metal shall be minimum 16 ga. as approved to produce surfaces equal to those specified for wood. Forms shall be matched, tight fitting, and stiffened to support weight of concrete.

F. Metal Form Deck: Utilized to support exterior slabs; shall be S.D.I. approved and equal to Vulcraft. Spacing of slab reinforcing shall be adjusted if required to match corrugations of metal deck.

G. Form Ties: Bolt and rod type so designed that upon removal of the form no metal shall be within 1-1/2" of the concrete surface and no holes larger than 1" in diameter. Concrete exposed to the exterior shall utilize galvanized ties.

H. Waterstops
   1. Expansion joints: Purpose made polyvinyl chloride (PVC) or rubber profile and size as indicated on drawings or as required by field conditions, maximum possible lengths as manufactured by Williams, Greenstreak or approved.
   2. Construction joints: Inorganic clay material manufactured from Wyoming type, high swelling bentonite as indicated on drawings as manufactured by American Colloid Company or approved.

I. Dovetail Anchor Slots: Galvanized steel, foam filled, release tape sealed slots, bond tab anchors as manufactured by Heckmann, Hohmann & Barnard, Inc. or approved.
J. Form Release Agent: Colorless mineral oil which will not stain the concrete or impair natural bonding characteristics of coating intended for use on concrete.

K. Formed Construction Joints for Slab-on-Grade: Galvanized steel, tongue and groove type profile with knockout holes to receive doweling, min. 26 gage unless noted otherwise. Size and profile as indicated on drawings or as required to fit field conditions.

L. Slab Edge Joint Filler: ASTM D994, premolded asphaltic board, thickness as indicated or (if not indicated, 1/2" thick minimum).

M. Vapor Barrier: Conforming to ASTM E1745 Class A, non-woven, .01 permeance, not less than 15 mils thick.

1. Acceptable Manufacturers:
   a. Stego wrap 15 mil vapor barrier by Stego Industries.
   b. WR Meadows Perminator 15 mil.
   c. Zero-perm by Alumiseal.
   d. Vaporblock VB15 by Raven Industries.
   e. Husky yello guard 15 mil vapor barrier by Poly-America L.P.

N. 6 mil thick, clear polyethylene film (for bond break between walls and floor), type recommended for below grade application.

N. Nails, spikes, lag bolts, through bolts, anchorages: Size as required, of sufficient strength and character to maintain formwork in place while placing concrete.

2.02 REINFORCEMENT MATERIALS

A. Reinforcing Bars: ASTM A 615 Grade 60 deformed.


C. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar-type supports complying with CRSI specifications.
1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
2. For exposed-to-view concrete surfaces where legs of supports are in contact with forms, provide supports with legs that are protected by plastic (CRSI, Class 1) or stainless steel (CRSI, Class 2).

D. Inert fiber reinforcement: Polypropylene fiber meeting ASTM-C1116; Fibermesh, Forta Corporation, or other Architect approved U.L. Listed. Add to plant mixed concrete at a rate of 1.5 lbs. per cubic yard of mix.

2.03 CONCRETE MATERIALS

A. Cement; controlling specification for Portland Cement, ASTM C150, Type I-Normal or Type II.

B. Aggregates shall conform to ASTM C-33. Maximum size of aggregate shall not be larger than 1/5 of narrowest dimension between forms of member for which concrete is to be used, nor larger than 3/4 of minimum clear spacing between reinforcing bars, nor larger than 1/3 of slab depth.

C. Lightweight aggregates shall conform to ASTM C 330.

D. Water: Clean and potable.

E. Air Entrainment Admixture: ASTM C260, as manufactured by Master Builders, Euclid, or W.R. Grace.

F. Chemical Admixtures: ASTM C494; Type 'A' - water reducing; Type 'B' - retarding, Type 'C' - accelerating, Type 'D' - water reducing and regarding, Type 'E' - water reducing and accelerating, Type 'F' - water reducing high range; Type 'G' - water reducing high range and retarding. Calcium chloride or admixtures containing more than .05 percent chloride ions by weight of admixture shall not be used. Each admixture shall not contribute more than 5 ppm by weight, of chloride ions to the total concrete constituent. Use admixtures in strict compliance with manufacturer's directions.

G. Fly Ash: ASTM C618, Type 'C' or 'F'.

CONCRETE 03001-5
H. Bonding Agent: Refer to Spec Section 03300 “Bonding Agents for Concrete”.

I. Non-Shrink Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents. Capable of developing a minimum compressive strength of 7000 psi at 28 days.
   a. Manufacturer: Dayton Superior Corp. or equal as approved by engineer.

J. Adhesive Anchoring: Injectable adhesive or self-contained capsule as manufactured by:
   1. 'Hilti' HIT System, or Architect approved/reviewed equal.

2.04 CURING COMPOUNDS & SEALERS

A. Curing Compound/Sealer: Liquid curing compound, water base, concrete curing-sealing compound, VOC (volatile organic content) compliant, containing fugitive dye that does not leave residue (resin, varnish, wax, etc.). Fugitive dye must disappear in 7 days, as manufactured by:
   1. Sonneborn Building Products, Kure-N-Seal W.
   2. Dayton Superior Corporation, Safe Cure & Seal (J-18).
   3. Burke by EDCO Spartan-Cote WB Cure Seal Hardener.
   4. MasterKure 100W, Master Builders, Inc.

B. Absorptive Mats: Burlap cloth, commercial quality suitable for purpose. Constructed of jute or kenaf, weighing approximately 9 oz. per square yard, complying with AASHTO M182, Class 2.

C. Moisture retaining cover, complying with ASTM C171; one of the following: waterproof paper, polyethylene film, or polyethylene coated burlap.

D. Crack Repair Material: Floor slabs – 2 part, 100% solid epoxy adhesive in formulation recommended by manufacturer for application, as manufactured by:
   1. W.R. Meadows Reziweld 1000 or Architect approved/reviewed equal.
E. Cure/Sealer Interior Exposed Concrete Floors: Curing compound, non-residual or dissipating resin curing compound. Product of sealer manufacturer and meeting sealer manufacturer's requirements. Manufacturers to include:

1. Dayton Superior Corp "Day-Chem Sil-Cure" (J-13).
2. L & M Cure or Cure R.

2.05 CONCRETE MIX

A. Mix concrete in accordance with ACI 304 and deliver concrete in accordance with ASTM C94.

B. Quality working stresses for the design of this project shall be based on specific minimum 28-day compressive strength of concrete or on specified minimum compressive strength at earlier age at which concrete may be expected to receive full load. Provide concrete of the following properties:

1. Exterior concrete; i.e. entry slabs, ramps, etc. - 4,000 psi. 28-day compressive strength; water-cement ratio, 0.40 maximum (air entrained).
2. Interior slab on ground - 4000 psi. 28-day compressive strength; water-cement ratio, 0.44 maximum (non-air entrained).
3. Footings, walls, supported slabs and all other concrete - 3,000 psi. 28-day compressive strength; water-cement ratio, 0.51 maximum (non-air-entrained), 0.46 maximum (air entrained).

C. Slump Limits: Proportion and design mixes to result in concrete slump at the point of placement as follows:

1. Ramps and Sloping Surfaces: Not more than 3".
2. Reinforced Foundation Systems: Not less than 1" and not more than 4".
3. All Other Concrete: Not less than 1" & not more than 4".
4. Concrete containing high-range water-reducing admixture (superplasticizer). Not more than 8 inches after adding admixture to site-verified 2-3 inch slump concrete.
5. Site added water to increase slump is strictly prohibited.
D. Proportions of aggregate to cement shall be such as to produce a mixture which will work readily into corners, angles of forms, and around reinforcement without permitting materials to segregate. Excess free water shall not collect on concrete surface.

E. Fly ash shall not exceed 25% of cement content by weight. No fly ash shall be used in slabs.

F. Select admixture proportions for normal weight concrete in accordance with ACI 301, Method 1 and in strict accordance with manufacturer's instructions.

G. Air Entraining Agent: Use in all exterior concrete exposed to weather; i.e. exposed foundation walls, supported slabs, ramps, etc. Air entrainment shall be accomplished by use of approved additives used in accordance with manufacturer's instructions. Limit air to 4% minimum to 7% maximum.

H. Adjustment to concrete mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather or other circumstances warrant, as accepted by the Architect. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Architect before using in work.

PART 3. EXECUTION

3.01 FORMWORK ERECTION

A. Erect formwork, shoring and bracing to achieve design requirements. Fabricate forms for easy removal without hammering or prying against exposed concrete surfaces.

B. Provide bracing to ensure stability of formwork.

C. Apply form release agent to formwork in accordance with manufacturer's instructions, prior to placing for accessories and reinforcement.

D. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent.

E. Clean forms as erection proceeds, to remove foreign matter.
F. Footings and foundations shall be formed, notched and/or sleeved as indicated to provide for installation of mechanical, electrical or plumbing piping/conduit.

G. Forms shall conform to shape, lines and dimensions of members as called for, substantially and sufficiently tight to prevent leakage of concrete.

H. Forms shall be properly braced, and tied together so as to maintain position and shape. Forms for exposed concrete shall be braced so as to provide dimensions called for, and have taped joints.

I. Construction joints, whether indicated on drawings or not, shall be made or located so as to least impair strength of the structure. Where joint is to be made, the surface of the concrete shall be thoroughly cleaned and all latency removed. In addition, vertical joints shall be keyed.

3.02 INSERTS, EMBEDDED COMPONENTS, AND OPENINGS

A. Provide formed openings where required for work to be embedded in and passing through concrete members.

B. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors and other inserts.

C. Install concrete accessories straight, level, and plumb.

3.03 REINFORCEMENT PLACEMENT

A. Place reinforcement, supported and secured against displacement.

B. Ensure reinforcing is clean, free of loose scale, dirt, or other foreign coatings.

C. Provide for continuity of reinforcing around corners in footings and walls. Lap corner bars 30 bar diameters.

D. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.04 PLACING CONCRETE
A. Prepare previously placed concrete by cleaning with steel brush and applying bonding agent. Apply bonding agent in accordance with manufacturer's instructions.

B. Install vapor barrier under interior slab-on-grade.
   1. Installation shall be in accordance with manufacturer’s instructions and ASTM E164 3-98.
      a. Unroll vapor barrier with the longest dimension parallel with the direction of the pour.
      b. Lap vapor barrier over footings and seal to foundation walls.
      c. Overlap joints 6 inches and seal with manufacturers tape.
      d. Seal all penetrations (including pipes) per manufacturers instruction.
      e. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
      f. Repair damaged areas by cutting patches of vapor barrier material overlapping the damaged area 6 inches and taping all four sides with tape.

C. Separate exterior slabs-on-grade from vertical surfaces with ½ inch thick joint filler, extended full thickness of slab. Also, provide filler strips at supported slabs and vertical surfaces. At interior slabs-on-grade locations, provide bond break from vertical surfaces consisting of 6 mil polyethylene film or 15# asphalt building paper and where indicated on plans.

D. Place concrete continuously between predetermined control and construction joints. Do not break or interrupt successive pours such that cold joints occur. Where applicable, construction joints shall occur at control joint locations, unless noted otherwise.

E. Concrete slabs on grade shall be constructed of thickness indicated. If thickness is not indicated, provide a minimum thickness of 4". Minimum thickness at pipes embedded in concrete shall not be less than three times o.d. of the pipe. All buried piping shall have been tested before placement of concrete.

F. Provide interior control joints where called for on drawing as detailed. When interior construction joints
occur, they shall also be considered as control joints. Provide sawed groove similar to a control joint at all construction joints.

G. Concrete shall be conveyed from the mixer to place of final deposit by methods which will prevent separation and loss of material.

H. All equipment used for transporting equipment shall be cleaned of all debris. Ice shall be removed from all places to be occupied by concrete forms, and masonry fillers shall be thoroughly wetted except where air temperatures are below 40 degrees F.

I. Equipment for chuting, pumping, pneumatically conveying concrete, shall be such size and design as to insure practically continuous flow of concrete at delivery and without separation of materials.

J. Concrete shall be deposited as soon as practicable in its final position to avoid segregation due to re-handling, flowing. Concreting shall be carried on at such rate that concrete is at all times plastic and flow readily into space between bars. No concrete that has partially hardened or has been contaminated by foreign materials shall be deposited on work, nor shall re-tempered concrete be used.

K. Concreting, once started, shall be carried on as a continuous operation until placing of panel or section is completed. Top surface shall be generally level.

L. All concrete shall be thoroughly compacted by suitable means during operation of placing and shall be thoroughly worked around reinforcement, embedded fixtures, and into corners of forms. Vibrator shall not be used to flow concrete.

M. Where new concrete is doweled to existing work, drill holes in existing concrete, insert steel dowels and pack with non-shrink grout or chemical adhesive. Follow manufacturer's recommendations for installation.

N. Screed floors slabs-on-grade and concrete base for toppings level, maintaining surface flatness of maximum 1/8 inch in 10 ft.
O. Construct all concrete site work items to shape, size, thickness and elevations shown. Concrete supported slabs shall be 4" thick on 1" form deck with reinforcing as indicated, unless otherwise shown. Side form all work. Slope surfaces of supported slabs, 1/4" per foot to low side or as directed by Architect/Engineer.

P. Provide 1/2" bituminous expansion joint filler along all joints where supported slabs abut other walks, building walls, etc.

Q. Protecting and sealing: Protect concrete supported slabs, ramps, platforms, slabs, etc., from pedestrian traffic for three days after pouring. Concrete shall be cured using two layers of burlap kept wet for minimum of 5 days; or at Contractor's option, he may use sprayed-on compound according to manufacturer's recommendations as approved by Architect. Curing method used shall not discolor original color of concrete, nor shall white liquid curing compound be used.

R. Provide concrete pads, bases, foundations, etc., as indicated and/or required by mechanical, electrical or other equipment supplier. Set anchor bolts for machine and equipment to templates or measurements provided.

3.05 FORM REMOVAL

A. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads.

B. Remove formwork progressively and in accordance with code requirements.

3.06 FLOOR FINISHING

A. Finish concrete floor surfaces in accordance with ACI 301 and ACI 302.

B. Uniformly spread, screed, and float concrete.

C. Steel trowel surfaces which will be left exposed.

D. In areas with a floor drain, maintain floor level at walls and pitch surfaces uniformly to drains.
E. Floor shall be finished without excessive floating. Delay troweling until concrete is sufficiently hard to prevent water working to surface. Bring finish to smooth level surface with minimum troweling possible.

F. Finishes, other than floors, exposed on exterior or interior shall be formed true, free from marks, irregularities. Remove any loose material, grind all projections, fill any honeycombing or holes, finish smooth. Use carborundum stone to hand rub and provide smooth, even surface where directed.

G. Thoroughly clean and prepare concrete floors scheduled to receive a sealer. Apply in strict accordance with manufacturer's instructions.

3.07 CURING

A. Place absorptive matting and dampen as required.

B. Immediately after placement, protect concrete from premature drying.

C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.

D. Provisions shall be made for maintaining concrete in moist condition for at least 5 days after placement, except high early concrete which shall be cured for at least 2 days.

E. Cold Weather Requirements:

1. General: Except as modified herein, all work shall be in accordance with ACI 306R.
2. Adequate equipment shall be provided for heating concrete materials and protecting concrete during freezing or near freezing weather. No frozen materials or materials containing ice shall be used.
3. All concrete materials, all reinforcement, forms, fillers, ground with which concrete is to come in contact shall be free from frost. Whenever temperature of surrounding air is below 40° F., all concrete placed in forms shall have a temperature of between 70° F., 80°F. Adequate means shall be
provided for maintaining temperature of not less than 70°F. for 3 days, 50°F. for 5 days, except high-
early concrete shall have temperature maintained at
not less than 70°F. for 2 days, 50°F. for 3 days, or for as much more time as necessary to insure
proper curing. Housing, covering, other protection
used in connection with curing shall remain in place
at least 24 hours after artificial heating is
discontinued. No dependence shall be placed on salt
or other chemicals for prevention of freezing.

F. Weather Conditions:

1. In hot weather, sprinkle and cover all concrete for
at least 24 hours longer than specified for normal
curing periods. In hot weather work shall be in
accordance with ACI 305R.

2. In weather when temperature falls below freezing, and
in any event between December 1 and April 1, no
concrete shall be poured without adequate frost
protection.

3.08 CONCRETE FINISHING

A. Provide concrete surfaces to be left exposed, concrete
walls, columns, etc., with smooth rubbed finish not later
than one day after form removal.

1. Moisten concrete surfaces and rub with carborundum
brick or another abrasive until producing a uniform
color and texture. Do not apply cement grout other
than that created by the rubbing process.

2. Provide ¾” x ¾” beveled edges at corners of exposed
concrete.

3.09 FIELD QUALITY CONTROL

A. Inspection and testing shall be performed by an
independent firm selected by the Owner and retained by
the Contractor, in accordance with Division 1, Section
01400 “Quality Control”.

B. The Contractor shall notify the Architect/Engineer and
the Testing Lab at least five (5) days prior to the
commencement of concrete operations.
C. See Division 1 for inspection and testing allowances, Section 01400 “Quality Control”.

D. Specimens shall be molded and cured as per ASTM C31. Three specimens per test, not less than one test for each day's pour, each 50 yards concrete poured, each building unit, or each strength concrete. Specimens shall be laboratory cured.

E. Specimens shall be tested in accordance with ASTM C39. One specimen shall be tested at 7 days, two at 28 days.

F. When average strength of laboratory control cylinders fall below required compressive strength, Architect shall have right to order change in proportions and water content for remainder of structure. Architect shall have right to require tests as per ACI Building Code; Chapter 20 where load tests show concrete does not conform with drawings or specifications. Deficiency shall be corrected without additional cost to Owner.

G. Four copies of test reports at 7 days, 28 days, shall be sent directly to the Architect by the Testing Laboratory, with all required information shown.

H. Slump tests per ASTM C-172 and C-143, minimum of one test for each set of cylinders, or more as conditions warrant. Deliveries exceeding specified slump shall be rejected.

3.10 DEFECTIVE CONCRETE

A. Modify or replace concrete not conforming to required lines, details and elevations, as directed by the Architect/Engineer.

B. Failure of concrete topping to bond to substrate (as evidenced by a hollow sound when tapped), or disintegration or other failure of topping to perform as a floor finish, will be considered failure of materials and workmanship. Repair of replace toppings in areas of such failures, as directed.
SECTION 03300 – BONDING AGENTS FOR CONCRETE

PART 1. GENERAL

1.01 SUMMARY

A. This specification describes the use of a bonding bridge between new portland-cement mortar or concrete and hardened portland-cement mortar or concrete.

1.02 QUALITY ASSURANCE

A. Manufacturing qualifications: The manufacturer of the specified product shall have in existence a recognized quality assurance program and be ISO 9001 Certified, a program of training, certifying and technically supporting a nationally-organized Approved Contractor Program with a re-certification program of its participants for a minimum of 5 years.

B. Contractor qualifications: Contractor shall be an Approved Contractor of the manufacturer of the specified product, who has completed a program of instruction in the use of the specified coating material, and provides a certification from the manufacturer attesting to its Approved Contractor status.

C. Install materials in accordance with all safety and weather conditions required by manufacturer, or as modified by applicable rules and regulations of local, state and federal authorities having jurisdiction. Consult Material Safety Data Sheets for complete handling recommendations.

1.03 DELIVERY, STORAGE AND HANDLING

A. All materials must be delivered in original, unopened containers with the manufacturer’s name, labels, product identification, and batch numbers. Damaged material must be removed from the site immediately.

B. Store all materials off the ground and protect from rain, freezing or excessive heat until ready for use.

C. Condition the specified product as recommended by the manufacturer.

1.04 JOB CONDITIONS

A. Environmental Conditions: Do not apply material if it is raining or snowing or if such conditions appear to be imminent. Minimum application temperature 40°F (5°C) and rising.

B. Protection: Precautions should be taken to avoid damage
to any surface near the work zone due to mixing and handling of the specified coating.

1.05 SUBMITTALS

A. Submit two copies of manufacturer’s literature, to include: Product Data Sheet, System Data Sheet, Application Guide, and appropriate Material Safety Data Sheets (MSDS).

B. Submit copy of Certificate of Approved Contractor status by manufacturer.

1.06 WARRANTY

A. Provide a written warranty from the manufacturer against defects of materials for a period of five (5) years, beginning with date of substantial completion of the project.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. Sika Armatec 110 EpoCem, as manufactured by Sika Corporation, 201 Polito Avenue, Lyndhurst, NJ 07071 is considered to conform to the requirements of this specification.

2.02 MATERIALS

A. Epoxy resin/portland cement adhesive shall be Sika Armatec 110 EpoCem.

1. Component “A” shall be an epoxy resin/water emulsion containing suitable viscosity control agents. It shall not contain butyl glycidyl ether.

2. Component “B” shall be primarily a water solution of a polyamine.

3. Component “C” shall be a blend of selected portland cements and sands.

4. The material shall not contain asbestos.

2.03 PERFORMANCE CRITERIA

A. Properties of the mixed epoxy resin/portland cement adhesive.

1. Pot Life: 90 minutes @ 73°F.

2. Contact Time: 95°F (35°C) 6 hours
   68°F (20°C) 12 hours
   50°F (10°C) 16 hours
   40°F (5°C) 24 hours

3. Color: Dark gray

B. Properties of the cured epoxy resin/portland cement adhesive.
1. Compressive Strength (ASTM C-109)
   a. 3 day: 4500 psi (31.0 MPa)
   b. 7 day: 6500 psi (44.8 MPa)
   c. 28 day: 8500 psi (58.6 MPa)

2. Splitting Tensile Strength (ASTM C-496)
   a. 28 days: 600 psi (4.1 MPa)

3. Flexural Strength (ASTM C-348)
   a. 1250 psi (8.6 MPa)

4. Bond Strength ASTM C-882 at 14 days
   a. Wet on Wet, 0-hr. open time: 2800 psi (19.3 MPa)
   b. 24-hr. open time: 2600 psi (17.9 MPa)

5. Bond of Steel Reinforcement to Concrete (Pullout Test)
   a. Sika Armatec 110 coated: 625 psi (4.3 MPa)
   b. Epoxy coated: 508 psi (3.5 MPa)
   c. Plain Reinforcement: 573 psi (3.95 MPa)

6. The epoxy resin/Portland cement adhesive shall not produce a vapor barrier.

7. Material must be proven to prevent corrosion of reinforcing steel when tested under the procedures as set forth by the Federal Highway Administration Program Report No. FHWA/RD86/193. Proof shall be in the form of an independent testing laboratory corrosion report showing prevention of corrosion of the reinforcing steel.

Note: Tests above were performed with material and curing conditions at 73°F and 45-55% relative humidity.

PART 3 - EXECUTION

3.01 MIXING AND APPLICATION

A. Mixing the epoxy resin: Shake contents of Components “A” and Component “B”. Completely empty both components into a clean, dry mixing pail. Mix thoroughly for 30 seconds using a jiffy paddle with a low-speed (400-600 rpm) drill. Slowly add the entire contents of Component “C” while continuing to mix for 3 minutes until uniform with no lumps. Mix only that quantity that can be applied within its pot life.

B. Placement procedure for Bonding bridge:
   1. Apply to prepared surface with a stiff-bristle
brush, broom or “hopper-type” spray equipment.

a. For hand-applied mortars—Place fresh, plastic concrete/mortar while the bonding bridge adhesive is “wet” or within open times indicated in section 2.03.A.2.

b. For machine-applied mortars—Apply while the bonding bridge adhesive is “wet” or within the open times indicated in section 2.03.A.2.

C. Placement procedures for anti-corrosion coating:

1. Apply to prepared steel surface with a stiff-bristle brush, or “hopper type” spray equipment at 20 mils minimum thickness. Properly coat the underside of the totally exposed steel. Allow to dry (approx 2-3 hours) then apply a second coat at 20 mils minimum thickness. Allow drying again before placing repair mortar.

*During the anti-corrosion coating method, after applying the second coat Sika Armatec 110 EpoCem, a mortar can be applied to “wet” Sika Armatec 110 EpoCem or within open times indicated in section 2.03.A.2 to achieve the benefit of bonding bridge.

D. Adhere to all limitations and cautions for the epoxy resin/Portland cement adhesive in the manufacturer’s current printed literature.

3.02 CLEANING

A. The uncured epoxy resin/Portland cement adhesive can be cleaned from tools with water. The cured epoxy resin/Portland cement adhesive can only be removed mechanically.

B. Leave finished work and work area in a neat, clean condition without evidence of spillovers onto adjacent areas.

END OF SECTION 03300
SECTION 04100 - MORTAR & GROUT

PART 1. GENERAL

1.01 RELATED DOCUMENTS

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this specification. Refer to Structural Drawings for additional information.

1.02 SECTION INCLUDES

A. Work included in this section consists of furnishing all labor, materials, equipment, and incidentals required for complete installation of mortar and grout for masonry.

B. Related work specified elsewhere:
   1. Section 03001 Concrete (Non-shrink grout).

1.03 ENVIRONMENTAL REQUIREMENTS


PART 2. PRODUCTS

2.01 MATERIALS

A. Portland Cement: ASTM C150, Type 1 provide natural color or white cement as required to provide mortar color indicated.

B. Mortar Aggregate: ASTM C144, standard masonry type.

C. Hydrated Lime: ASTM C207, Type 'S', or 'N'.

D. Masonry Cement: ASTM C91.

E. Premix Mortar: ASTM C387.

F. Grout Aggregate: ASTM C404.

G. Grout Fine Aggregate: ASTM C144, 100% passing #8 sieve, maximum 5-30% passing #50 sieve.

H. Water: Clean and potable.
I. Integral water repellant additive meeting ASTM E-514.

J. Plasticizer:
   1. SIKA Chemical Corporation "Intraplast Z".
   2. Euclid Chemical Co. "Eucon BK-S".

K. Storage of all material shall prevent the intrusion of foreign matter. Store all masonry units on the ground, protected against damage and intrusion of excess moisture. No damaged or deteriorated materials shall be used.

2.02 MORTAR MIXES

A. Mortar for exterior load bearing walls and all exterior masonry work below grade; ASTM C270, Type 'M' or 'S', using the property method unless noted otherwise on structural drawings. Use ASTM C270 Type 'N' above grade at exterior veneers.

B. Mortar for interior non-load bearing walls and partitions: ASTM C270, Type 'M' or 'S', using the property method.

C. Mortar for reinforced masonry ASTM C270, Type 'S', using the property method.

D. Pointing mortar for masonry veneers ASTM C270, Type 'N', using the property method.

E. Mortar Pigments: Natural and synthetic milled, blended iron oxides, compounded for use in mortar mixes. Use only pigments with a record of satisfactory performance in masonry mortars.

   1. Provide colored mortar pigments: Color shall be as selected by Architect from SGS concentrated A, H and X Series mortar colors as manufactured by Solomon Colors, Springfield, IL 800-624-0261.
      a. Carbon added for darker colors shall not exceed 4%.
      b. Mix shall product uniform and consistent color.
      c. Inert, stable to atmospheric conditions, sun fast, weather resistant, alkali resistant, water insoluble, lime proof and non bleeding.
      d. Free of deleterious fillers and extenders.
      e. Practice size: 95 to 99% minus 325 mesh.
f. pH: 6.5 to 9.0.
g. Shall be tested per ASTM C91 and ASTM C270. Exceed 1800 psi at 28 days strength requirement.

F. Ready-Mixed Mortar: Cementitious materials, water, and aggregate complying with requirements specified in this Article; combined with set-controlling admixtures to produce a ready-mixed mortar complying with ASTM C 1142.

G. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494, Type C and ASTM C1384, and recommended by the manufacturer for use in masonry mortar of composition indicated.

2.03 MORTAR MIXING

A. Thoroughly mix mortar ingredients in approved type mixing machine in quantities needed for immediate use in accordance with ASTM C270 or C780. Discharge mixer completely before recharging.

B. All exterior above grade mortar exposed to moisture shall be fabricated with integral water repellent additive.

C. Blend admixtures in accordance with manufacturer's instructions.

D. Do not use anti-freeze compounds to lower the freezing point of mortar.

2.04 GROUT MIXES

A. Bond beams, lintels, engineered masonry, reinforced masonry walls: min. 2000 psi strength at 28 days unless noted otherwise; 8-10 inches slump; pre-mixed grout in accordance with ASTM C94, or batch mixed in accordance with ASTM C476 for fine or course grout.

PART 3. EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Apply bonding agent to existing concrete surfaces.
3.02 INSTALLATION

A. Install pre-mix mortar and grout in accordance with manufacturer's instructions.

B. Work grout into masonry cores and cavities to eliminate voids. Do not displace reinforcement. Reinforcing shall be mechanically anchored in masonry cores to prevent displacement during grouting.
SECTION 04300 - UNIT MASONRY

PART 1. GENERAL

1.01 RELATED DOCUMENTS

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this specification.

1.02 SECTION INCLUDES

A. Work included in this section consists of furnishing all labor, materials, equipment and incidentals required for complete installation of concrete masonry and brick units including installation of reinforcement, anchorage and accessories. Refer to Structural Drawings for additional information.

B. Related work specified elsewhere:
   1. Section 04100 - Mortar & grout.
   2. Section 04720 - Cast Stone
   3. Section 07175 - Water Repellant Coatings
   4. Section 07200 - Building Insulation
   5. Section 07920 - Sealants & Caulking

1.03 PERFORMANCE REQUIREMENTS

A. Provide unit masonry that develops the following installed compressive strengths (f'm) at 28 days.

   1. For concrete Unit Masonry: As follows, based on net area:
      a. f'm = 1900 psi (13.05 MPa).

   2. For Brick Unit Masonry: As follows, based on gross area:
      a. f'm = 1500 psi (10.3 MPa).

1.04 SUBMITTALS

A. Provide data on concrete masonry units.

B. Reinforcing steel shop drawings (refer to Structural Drawings for additional information).
C. Shop drawing for cast stone trim including cutting and setting diagrams.

D. If specifically requested by the Architect/Engineer, provide samples for verification as follows.

1. Full-size units for each different exposed masonry unit required showing the full range of exposed colors, textures, and dimensions to be expected in the completed construction.
2. Stone trim samples not less than 12 inches (300 mm) in length showing the full range of colors and textures expected in the finished construction.
3. Weep holes/vents in color to match mortar color.
4. Accessories embedded in the masonry.

1.05 QUALITY ASSURANCE

A. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by another means, as acceptable to authorities having jurisdiction.

B. Single-Source Responsibility for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from one source and by a single manufacturer for each different product required.

C. Single-Source Responsibility for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from one manufacturer for each cementitious component and from one source or producer for each aggregate.

1.06 ENVIRONMENTAL REQUIREMENTS

A. Hot and Cold weather requirements: Recommended Practices for Hot or Cold Weather Masonry Construction as published by the Masonry Industry Council.

1.07 DELIVERY, STORAGE, AND HANDLING
A. Store masonry units on elevated platforms, under cover, and in a dry location to prevent their deterioration or damage due to moisture, temperature changes, contaminants, corrosion, and other causes. If units become wet, do not install until they are in an air-dried condition.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

PART 2. PRODUCTS

2.01 CONCRETE MASONRY UNITS

A. Concrete block (CMU): ASTM C90, normal weight (>125 pcf). Use for above and below grade, exterior or interior wall applications. Provide units made with “dry block” as manufactured by W. R. Grace & Company (or approved) for exterior wall applications. This includes exterior walls with veneers.

1. Texture of exposed faces of block shall be uniform for all block used in this project. Solid units may be used for bearing under structural members. No units with exposed chipped surfaces will be permitted in areas where exposed.

2. Provide shapes such as special units at pilaster blocks, bullnose all external corners, sash recesses, square ends, lintel blocks and other, as required by drawings or specifications.

B. Split Face Masonry Units with Krete:

1. Standards: Units shall be normal weight block, withstanding compression test loads of at least 3,000 p.s.i. for individual units, or 3,500 p.s.i. for an average of five units, basing load figures on the average net area of the blocks. Units shall meet or exceed requirements specified for Type I, ASTM C55-97A.

2. Manufacturer: Units specified herein are based on those manufactured by Grand Blanc Cement Products, Inc. Grand Blanc, Michigan, Phone: 1-800-875-7500.
The same manufacturer shall produce all visually related block.

3. Finish: Splitface units are to be selected from colors using natural dense aggregates including those with white cement/white aggregate. Samples shall be submitted for establishing an approved range of color variation and texture. Color to be Meadowbrook Blend.

4. Shape: Splitface Block shall conform to Grand Blanc Cement Products series full face split, Standard pattern as detailed.

2.02 STRUCTURAL GLAZED FACING TILE (SGFT)

A. Glazed units shall be “stark ceramic” structural glazed facing tile, available at Indiana Brick Corporation or equal products as manufactured by Elgin-Butler. (Grade SS 6T series, double and single faced units, thickness as indicated on plan. Provide one side with block textured units where indicated on drawings. Provide complete with all special shapes, bullnose units, lintels, etc. as required to complete construction. Provide vertical coped units where units are shown to have vertical reinforcing.

2.03 BRICK UNITS

A. Face Brick: ASTM C216, Type FBS, Grade SW.

B. Brick Masonry Units: Modular size of 2¼” x 3-5/8” x 7-5/8”

1. Provide special units of shape and size including solids as noted on drawings.

C. Provide brick as follows:

1. Field Brick: Glen Geary, Rustic Myrrh Velour
   a. Available at Glen Gery Masonry Supply Center, Waterford, MI 248-717-2114.

2.04 REINFORCEMENT AND ANCHORAGE
A. All single wythe joint reinforcement shall be ladder type wire reinforcing consisting of No. 9 gauge deformed side rods, with No. 9 gauge standard ladder type cross rods. All rods shall be hot-dip galvanized using ASTM A153, Class B-2 standards. Out to out spacing of side rods shall be approximately 2" less than the nominal wall thickness. Provide pre-fabricated corners and tee units as required.

B. All multiple wythe/cavity wall joint reinforcement shall be adjustable ladder type hot-dip galvanized in accordance with ASTM A153, Class B-2 standards. Separate adjustable ties extend to engage outer wythe by at least 2" and spaced not more than 16" o.c.

1. Use where horizontal joints of facing wythe do not align with those of back-up and where indicated.
2. Use where facing wythe is of different material than back-up wythe.

C. For anchorage to steel framing, provide manufacturer's standard anchors with crimped 1/4 inch (6.4 mm) diameter wire anchor section for welding to steel and triangular-shaped wire tie section sized to extend within 1 inch (25 mm) of masonry face and wire diameter of 0.25". Provide one tie on each side of framing where masonry abuts. Ties to be spaced at 16" o.c. vertical

D. Adjustable Steel Wire Wall Ties (For Veneer w/CMU Backup): Formed wire 3/16" diameter high tensile, cold drawn steel wire conforming to ASTM A82, galvanized zinc coated finish, installed at 16" o.c. vertical opposite ladder reinforcing. Provide one tie per 2.66 square feet of wall area minimum.

E. Manufacturers:
   1. AA Wire Products Co.
   2. Dur-O-Wal.
   4. Hohmann and Barnard, Inc.
   5. Wire Bond
   6. Other Architect Approved.

F. Reinforcing Steel: ASTM A615, 60-ksi-yield grade deformed steel bars unprotected finish.
2.05 FLASHINGS


2.06 ACCESSORIES

A. Building Paper: 15# asphalt saturated felt.

B. Column Wrap: Waxed corrugated cardboard or 15# asphalt saturated felt.

C. Cavity Wall Insulation: Polystyrene insulation. Refer to Section 07200.

D. Weep Vents: Plastic Weep Vent: One-piece, flexible extrusion manufactured from ultraviolet-resistant polypropylene copolymer, designed to weep moisture in masonry cavity to exterior, sized to fill head joints with outside face held back 1/8 inch from exterior face of masonry, in color selected from manufacturer’s standard.

E. Cavity Drainage Material: 1-inch (25 mm) thick, reticulated, nonabsorbent mesh, made from polyethylene strands and shaped to maintain drainage at weep holes without being clogged by mortar droppings.

1. Product: Subject to compliance with requirements, provide “Mortar Net” by Mortar Net USA, Ltd or Architect approved.

F. Liquid Applied Air Barrier.

2.07 LINTELS

A. Lintels shall be steel, precast or cast-in-place in accordance with details as shown or scheduled on the drawings.
A. Verify that field conditions are acceptable and ready to receive work. Examine rough-in and built-in construction to verify locations prior to installation.

B. Coordinate placement of anchors supplied to other sections.

C. Employ skilled mechanics, experienced supervision. Lay masonry plumb, true to line, with level, accurately spaced courses. Break vertical joints unless otherwise indicated. Keep bond plumb. Rack courses, where necessary, without toothing. Lay out facing before setting, minimize cutting closures, jumping bond.

D. Do not wet concrete masonry. Lay masonry with complete bearing in full beds of mortar. Butter sides for full vertical joints. Shove units into place. Anchor walls not otherwise bonded with ties every 8", every four (4) courses.

E. Cover top of masonry work at end of day's work with reinforced waterproof non-staining membrane. When air temperature is below 40°F., heat masonry materials, provide cold weather protection necessary to maintain temperature from 40°F. for 48 hours, both sides of masonry.

F. Blend brick on site in percentages as indicated to achieve specified blend and range.

G. Mix units for exposed unit masonry from several pallets as they are placed to provide a uniform blend of colors and textures.

3.02 COURSING

A. Maintain masonry courses to uniform dimension. Form vertical and horizontal joints of uniform thickness. Lay out walls in advance for accurate spacing of openings, movement type joints, returns, etc. Avoid units of less than half size at corners and jambs.

B. Block unit shall be laid in stack or running bond, as indicated on drawings with vertical joints aligned plumb, horizontal joints level. Joints in back-up work shall be worked out to provide bonding with facing masonry. Joints shall be uniform in width, thickness not to exceed 1/3".

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Exposed joints in finish work shall be tooled slightly concave, others shall be cut flush.

C. Brick Units: Lay in running, stacked, rowlock and soldier bonds where noted on drawings. Course as detailed on drawings. Form raked or concave mortar joints as detailed.

D. Initial block course (first course above foundation) in walls (interior or exterior) shall be laid in full mortar beds on shells and cross webs; in other locations, units shall be laid in full mortar beds on shells only. Solid block units shall be laid same as brick. Vertical joints between units shall be filled with mortar between shell ends.

E. All non-bearing walls and partitions shall terminate against beam soffits, roof, or structural ceilings, unless otherwise shown on drawings, or as stated below. Build wall to within 3/8" of overhead structure on roof, fill top joint and all voids with non-combustible insulation board which has width of 1" less than wall, then caulk joints. Provide lateral support at top of the walls as indicated.

F. Both bearing and non-bearing masonry walls shall have the top joint as well as all voids at roof deck/floor deck and elsewhere in or over these walls, filled with cement grout, mortar, or plaster bed of at least 2" in width. Where no ceilings occur in the room, said fill shall be troweled flush with the wall surface or surfaces on the exposed side of the wall.

G. All interior and exterior block walls shall have control joints 20'-0" o.c. maximum for exterior and 25'-0" to 30'-0" at interior walls. Line up control joints with joints in foundation wall and joints in face brick. Leave exposed faces on joints ready for caulking. Provide vertical reinforcing in grouted core on each side of exterior masonry control joints. Reinforcing to match vertical wall steel.

H. Bond each course at corners and break vertical joints at least 2". Tee shaped or cross shaped intersecting walls shall have vertical continuous joint. These joints shall be caulked. Provide for continuity of joint reinforcing by providing pre-fabricated "T" shaped or "L" shaped units.
I. Provide welded steel masonry reinforcing placed in every second horizontal course in all block walls with at least one layer below a window sill level and one layer above a lintel level. Lay reinforcing on wall and cover with mortar, bed unit as usual. Longitudinal wire shall be lapped not less than 32 diameters at splices. At corners, cut inside rod and bend to proper angle.

J. Construct bond beams as indicated with concrete grout. Maintain accurate location of reinforcing steel during grout placement.

K. Grout course solid (or use solid units) immediately below veneer, where masonry serves as support for the veneer (i.e. brick ledges).

L. Stopping and Resuming Work: In each course, rack back 1/2-unit length for one-half running bond or 1/3-unit length for one-third running bond; do not tooth. Clean exposed surfaces of set masonry and remove loose masonry units and mortar prior to laying fresh masonry.

3.03 PLACING AND BONDING

A. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.

B. Isolate top joint of masonry partitions from horizontal structural framing members and slabs or decks with fire rated compressible joint filler.

3.04 WEEPS AND VENTS

A. Install weep holes in veneer at 24” on center horizontally or as indicated on drawings above through-wall flashing, above shelf angles, and at bottom of walls. Weeps shall be laid with masonry. Weep holes shall not be drilled, cut or carved into mortar joints.

3.05 CAVITY WALL

A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep holes. Provide layer of clean mason’s sand at base of cavity directly on through wall flashing of sufficient depth to cover weep holes.
B. Build inner wythe ahead of outer wythe to receive cavity insulation air/vapor barrier adhesive.

C. Tie exterior wythe to back-up with continuous horizontal joint reinforcing.

3.06 REINFORCEMENT & ANCHORAGES - SINGLE WYTHE MASONRY

A. Walls laid up with concrete block, including where used as back-up shall be reinforced with horizontal steel wall reinforcing as specified. Reinforcing shall be of proper width for block wythe, to have side wires over block shells. Place joint reinforcement at 16" o.c. vertical and continuous in first and second joint below top of walls.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum of 3'-0" beyond each side of opening.

C. Reinforcing in foundation walls (below floor slab) shall be placed every other course, continuous.

D. Terminate reinforcing each side of control joints; lap end joints 12", form corners by cutting and lapping inside wire, bending outside wire; form intersections by cutting and lapping reinforcing from one wall with other wall. Bed side wires completely in mortar.

3.07 REINFORCEMENT & ANCHORAGES - CAVITY WALL MASONRY

A. Install horizontal joint reinforcement 16 inches o.c. vertically. Place joint reinforcement continuous in first joint below top of walls.

B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.

3.08 MASONRY FLASHINGS

A. Extend flashings under, over and through veneer. Turn up minimum 8 inches and bed into mortar joint of backup masonry.

B. Lap end joints and seal watertight.
C. All discontinuous flashing shall be turned up one head joint past the opening jamb to form an end dam.

D. Use flashing manufacturer's recommended adhesive and sealer.

3.09 LINTELS

A. Install loose steel lintels over window openings, door openings and other miscellaneous openings as indicated on the structural plans.

B. Construct concrete block lintels over window openings, door openings and other openings as indicated on the structural plans or otherwise required.

C. Maintain minimum bearing each side of opening of 8" or as specified on structural drawings. Align end of lintel with vertical block joints.

3.10 GROUTED COMPONENTS

A. Reinforce bond beam and pilasters as detailed.

B. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.

C. Place and consolidate grout fill without displacing reinforcing.

D. At beam bearing locations, fill masonry cores with grout for a minimum 12 inches either side of member and three courses vertical, unless otherwise noted.

3.11 ENGINEERED MASONRY

A. Lay masonry units with core cells vertically aligned and cavities between wythes clear of mortar and unobstructed.

B. Reinforce masonry unit cores and cavities with reinforcement bars and grout as indicated. Provide vertical bars in corners. Provide vertical bars at each side of all masonry openings. Vertical bars to continue at noted spacing above openings.
C. Secure vertical reinforcement in position at top and bottom of cells and at intervals not exceeding 192 bar diameters. Splice reinforcement 48 bar diameters, minimum 12".

D. Place mortar in masonry unit bed joints back 1/4 inch from edge of unit grout spaces; bevel back and upward. Permit mortar to cure 3 days before placing grout.

E. Grout spaces less than 2 inches in width with fine grout using low lift grouting techniques. Grout spaces 2 inches or greater in width with coarse grout using high or low lift grouting techniques.

F. When grouting is stopped for more than one hour, terminate grout 1-1/2 inch below top of upper masonry unit to form a positive key for subsequent grout placement.

G. Low Lift Grouting: Place first lift of grout to a height of 60 inches maximum and consolidate by mechanical vibration. Place subsequent lifts in maximum 60 inch increments and vibrate grout for consolidation. Ensure mortar has gained sufficient strength to withstand pressure prior to grouting. “Puddling” may be used in lieu of mechanical vibration if grout lifts are limited to 12 inches maximum.

H. High Lift Grouting:
   1. Provide cleanout opening no less than 4 inches high at the bottom of each cell to be grouted by cutting one face shell of masonry unit.
   2. Clean out masonry cells and cavities with high-pressure water spray. Permit complete water drainage. Cells and cavities may be “cleaned” by using steel rod to remove excess mortar protrusions.
   3. Request that Architect/Engineer inspect the cells. Allow three days advance notice.
   4. After cleaning and cell inspection, seal openings with masonry units.
   5. Pump grout into spaces. Maintain water content in grout to intended slump without aggregate segregation.
   6. Limit grout lift to 60 inches and mechanically vibrate for grout consolidation. Wait 30 to 60 minutes before placing next lift.

3.12 CONTROL AND EXPANSION JOINTS
A. Do not extend horizontal joint reinforcement through control and expansion joints.

B. Form control joint with a sheet building paper bond breaker fitted to one side of the hollow contour end of the masonry unit. Fill the resultant elliptical core with grout fill. Rake joint at exposed unit faces for placement of backer rod and sealant.

C. Form expansion joints as detailed.

3.13 BUILT-IN WORK

A. As Work progresses, build in metal door and glazed frames, fabricated metal frames, window frames, wood nailing strips, anchor bolts, plates, and other items to be built in the Work furnished by other Sections.

B. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.

3.14 POINTING AND CLEANING

A. Point up all exposed brick where required, fill all holes and joints; remove loose mortar, cut out defective joints, and repoint where necessary.

3.15 TOLERANCES

A. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.

B. Maximum Variation from Level Coursing: 1/8 inch in 3 ft. and 1/4 inch in 10 ft.; 1/2 inch in 30 ft.

3.16 CUTTING AND FITTING

A. Cut and fit for chases, pipes, conduit, sleeves, grounds, and other items. Coordinate with other Sections of Work to provide correct size, shape, and location.
B. Form slots, grooves, chases, recesses, other items required for other trades. Build in all required structural steel, miscellaneous metal, sash anchors, precast concrete anchors, other items. Bed in mortar to line and level. Build in counter flashing furnished by Roofing Contractor. Check all requirements in advance to eliminate cutting.

C. Do necessary cutting of masonry for installation of items not otherwise provided for. Patch walls, maintain structural stability, appearance, weather resistance.

D. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting, where possible. Allow units cut with water-cooled saws to dry before placing, unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.17 REPAIRING, POINTING AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or if units do not match adjoining units. Install new units to match adjoining units; install in fresh mortar or grout, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point-up joints, including corners, opening, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for application of sealants.

C. Remove excess mortar and mortar smears.

D. Clean soiled surfaces with cleaning solution.

E. On completion of pointing and re-pointing of all face brick and block work, interior and exterior, clean thoroughly with "Sure Klean 600", "Craft Klean" (for splitface and burnished units, clean with custom masonry cleaner by Prosoco) or similar prepared detergent, applied strictly according to the manufacturer's instructions with
stiff fiber brushes. Drench with clean water immediately after cleaning. Do not use job mixed acid on this project. All cleaning shall be done prior to installation of any finished floor, wall mounted light fixtures, aluminum frames or items subject to damage. Protect hollow metal frames, other built-in items.

F. For cleaning pre-faced units, use masonry detergent cleaners in accordance with manufacturer’s directions. Do not use hydrochloric acids or other unbuffered acids. Do not use steel wool or other abrasives.

3.18 MASONRY WASTE DISPOSAL

A. Recycling: Undamaged, excess masonry materials are Contractor’s property and shall be removed from the Project site for his use.

END OF SECTION 04300
SECTION 04720 - CAST STONE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Bidding and Contract Requirements, and to General and Supplemental Conditions, hereby made a part of this Section.
   1. Section includes:
      a. Custom cast stone

1.02 RELATED SECTIONS:

A. Section 04100 - Mortar & Grout
B. Section 04300 - Unit Masonry
C. Section 07175 - Water Repellant Coatings
D. Section 07910 - Joint Fillers and Gaskets
E. Section 07920 - Sealants and Caulking

1.03 REFERENCES:

A. ASTM A 615/A 615 M - Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
B. ASTM A 767/A767M - Zinc-Coated (galvanized) Steel Bars for Concrete Reinforcement.
C. ASTM C 33 - Concrete aggregates.
F. ASTM C 90 - Loadbearing Concrete Masonry Units
G. ASTM C 140 - Sampling and Testing Concrete Masonry Units and Related Units
H. ASTM C 150 - Portland Cement
I. ASTM C 270 - Mortar for Unit Masonry
J. ASTM C 426 - Linear Drying Shrinkage of Concrete Masonry Units
K. ASTM C 494 - Chemical Admixtures for Concrete
1.04 DEFINITIONS:

A. Cast Stone: An architectural masonry unit manufactured to copy fine grain texture and color of natural cut stone.

B. Dry Cast Concrete Products: Manufactured from zero-slump concrete.

C. Machine Casting Method: Vibratory compaction by machine of earth-moist, zero-slump concrete against rigid mold until it is densely compacted.

D. Vibrant Dry Hand Tamp Casting Method: Vibratory compaction by hand tamp of earth-moist, zero-slump concrete against rigid mold until it is densely compacted.

1.05 SUBMITTALS:

A. Comply with Division 1 – Section 01340 “Shop Drawings, Product Data and Samples” for submittal requirements.

B. Product Data: Submit manufacturer’s Product Data

C. Shop Drawings: Submit manufacturer’s shop drawings, including profiles, cross sections, modular unit lengths, reinforcement if required, exposed faces, anchors and anchoring method recommendations if required and annotation of cast stone types and location.

D. Samples: Submit pieces of manufacturer’s cast stone units that represent general range of texture and color proposed to be furnished for project.
E. Test Results:
   1. Submit manufacturer’s test results from cast stone units previously made by manufacturer using materials from same sources proposed for use in project.
   2. Submit manufacturer’s test results from plant production testing.

F. Warranty: Submit manufacturer’s standard warranty.

1.06 QUALITY ASSURANCE
A. Manufacturer Qualifications:
   1. Sufficient plant facilities to provide quality, shapes, quantities, and sizes of cast stone units required without delaying progress of the work.
   2. Minimum of 10 years experience in producing masonry units or cast stone.

1.07 DELIVERY, STORAGE AND HANDLING
A. Delivery:
   1. Deliver cast stone units secured to shipping pallets and protected from damage and discoloration.
   2. Provide itemized shipping list.
   3. Number each piece individually, as required, to match shop drawings and schedules.

B. Storage
   1. Store cast stone units and installation materials in accordance with manufacturer’s instructions.
   2. Store cast stone units on pallets with non-staining, waterproof covers.
   3. Do not double stack pallets.
   4. Ventilate units under covers to prevent condensation.
   5. Prevent contact with dirt and splashing.

C. Handling:
   1. Protect cast stone units, including corners and edges, during storage, handling, and installation to prevent chipping, cracking, staining, or other damage.
   2. Handle long units at center and both ends simultaneously to prevent cracking.
1.08 SCHEDULING

A. Schedule and coordinate production and delivery of cast stone units with unit masonry work.

PART 2 - PRODUCTS

2.01 MANUFACTURER:

A. RockCast, Division of Reading Rock Inc., 4600 Devitt Drive, Cincinnati, OH 45246. Toll Free (800)482-6466. Phone (513)874-2345. Fax (513)874-2520. Web Site: www.rockcast.com. E-mail: info@rockcast.com

B. Custom Cast Stone Inc., 734 E. 169th Street, Westfield, Indiana 46074, toll free (888)776-9960 phone (317)896-1700 Fax (317)896-1701

C. Custom Stone Works, 32910 Plymouth Road, Livonia, MI 48150 Phone: (734) 427-8158 Fax: (734) 427-8178 Toll free: (877)40-GRANITE.

D. Or Equal as approved by Architect/Owner.

2.02 CUSTOM CAST STONE UNITS

A. Custom Cast Stone Units; RockCast Custom Cast Stone Series or Custom stone units.

B. Compliance: ASTM C 1364.

C. Casting Method: Vibrant dry hand tamp.

D. Texture: Smooth.

E. Color: As selected by Architect/Owner from manufacturer’s full selection of colors.

F. Units: As indicated on drawings.

G. Profiles: As indicated on drawings.

H. Test Results:
   1. Compressive Strength, ASTM C 1194: Greater than 6,500 psi at 28 days.
   2. Absorption: ASTM C 1195: 6.0 percent max at 28 days.
   3. Linear Shrinkage, ASTM C 426: Less than 0.065 percent.
   4. Density, ASTM C 140: Greater than 120 pounds per cubic foot.
   5. Freeze-Thaw, ASTM C 666: Less than 4.0 percent.
I. Curing: Cure in enclosed chamber at 95 percent relative humidity for 24 hours or yard cure for 350° days (i.e. 7 days @ 50°F or 5 days @ 70°F) prior to shipping.

J. Cast Stone type units, as indicated on drawings.

2.03 CAST STONE MATERIALS

A. Portland Cement: ASTM C 150, Type I or II. White and/or gray as required to match specified color.

B. Coarse Aggregate: ASTM C 33, except for gradation. Granite, quartz, or limestone.

C. Fine Aggregates: ASTM C 33, except for gradation. Manufactured or natural sands.


E. Water reducing, retarding, and accelerating admixtures: ASTM C 494.

F. Water: Potable.

G. Reinforcing Bars: ASTM A 615, deformed steel bars. Galvanized when covered with less than 1 ½ inches of material.
   1. Galvanized Coating: ASTM A 767

2.04 TEXTURE AND COLOR

A. General: Match texture and color of full-size sample on file with Architect.

B. Texture of surfaces exposed to view:
   1. Fine-grained texture similar to natural stone.
   2. Approximately equal to approved sample when viewed in direct daylight at 20 feet.

C. Surface Voids:
   1. Size: Maximum 1/32 inch.
   2. Density: Less than 3 occurrences per any 1 square inch.
   3. Viewing Conditions: Not obvious under direct daylight at 20 feet.
D. Minor Chipping:

1. Minor chipping resulting from shipping and delivery shall not be grounds for rejection of cast stone units.
2. Minor chips shall not be obvious under direct daylight at 20 feet, as determined by Architect.

E. Color Variation

1. Viewing Conditions: Compare in direct daylight at 20 feet, between cast stone units of similar age, subjected to similar weathering conditions.

2.05 MORTAR

A. Mortar: ASTM C 270, Type N, as specified in Section 04100 Mortar & Grout.

2.06 ACCESSORIES

A. Anchors: Type 304 stainless steel.
B. Sealant: As specified in Section 07920.
C. Cleaner: Prosoco Sure Klean 600 Detergent, or Prosoco Sure Klean Vana Trol as required per brick type.

2.07 FABRICATIONS

A. Shapes: Unless otherwise indicated on drawings, provide:
   1. Suitable wash on exterior sills, copings, projecting courses and units with exposed top surfaces.
   2. Drips on projecting units, wherever possible.
B. Reinforcement: As required to withstand handling stresses.

2.08 TOLERANCES

A. General: Manufacture cast stone units within tolerances in accordance with Cast Stone Institute Technical Manual, unless otherwise specified.
B. Cross Section Dimensions: Do not deviate by more than plus or minus 1/8 inch from approved dimensions.
C. Length of Units: Do not deviate by more than length/360 or plus or minus 1/8 inch, whichever is greater, not to exceed plus or minus ¼ inch.
D. Warp, Bow or Twist: Do not exceed length/360 or plus or minus 1/8 inch, whichever is greater.

2.09 PRODUCTION QUALITY CONTROL

A. Mix Designs: Test new and existing mix designs for compressive strength and absorption before manufacturing cast stone units.

B. Plant Production Testing: Test compressive strength and absorption from specimens selected at random from plant production. Obtain samples every 500 cubic feet of product produced.

1. Custom Cast Stone Units: Test in accordance with ASTM C 1194 and C 1195.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine construction to receive cast stone units. Notify Architect and the General Contractor in writing if construction is not acceptable. Do not begin installation until unacceptable conditions have been corrected.

B. Examine cast stone units before installation. Do not install unacceptable units.

3.02 INSTALLATION

A. Install cast stone units in conjunction with masonry, as specified in Section 04300 “Unit Masonry Work”.

B. Pull units from multiple cubes during installation to minimize variation in color.

C. Cut units using motor-driven masonry saws.

D. Do not use pry bars or other equipment in a manner that could damage cast stone units.

E. Fill dowel holes and anchor slots completely with mortar or non-shrink grout.

F. Set cast stone units in full bed of mortar, unless otherwise indicated on the drawings.

G. Fill vertical joints with mortar.
H. Make joints 3/8 inch, unless otherwise indicated on the drawings.

I. Leave head joints in copings and similar units upon for sealant.

J. Rake mortar joints 3/4 inch for pointing.

K. Tuck point mortar joints to slight concave profile.

L. Remove excess mortar immediately.

M. Remove mortar fins and smears before tooling joints.

N. Sealant Joints:

1. As specified in Sections 07910 “Joint Fillers and Gaskets” and 07920 “Sealants and Caulking”.
2. Prime ends of cast stone units, insert properly sized backing rod, and install sealant.
3. Provide sealant joints at following locations:
   a. Cast stone units with exposed tops.
   b. Joints at relieving angles.
   c. Control and expansion joints.
   d. As indicated on the drawings.

3.03 TOLERANCES


1. Variation from Plumb: Do not exceed 1/8 inch in 5 feet or 1/4 inch in 20 feet or more.
2. Variation from Level: Do not exceed 1/8 inch in 5 feet, 1/4 inch in 20 feet, or 3/8 inch maximum.

3. Variation in Joint Width: Do not vary joint thickness more than 1/8 inch or 1/4 of nominal joint width, whichever is greater.
4. Variation in Plane Between Adjacent Surfaces: Do not exceed 1/8-inch difference between planes of adjacent units or adjacent surfaces indicated to be flush with units.

3.04 CLEANING

A. Clean exposed units after mortar is thoroughly set and cured.

B. Wet surfaces before applying cleaner.
C. Apply cleaner to cast stone units in accordance with cleaner manufacturer’s instructions.

D. Perform test of cleaner on small area and receive approval by Architect before full cleaning.

E. Do **not** use the following to clean cast stone units:
   1. Muriatic acid.
   2. Power washing.
   2. Harsh cleaning materials or methods that would damage or discolor surfaces.

3.05 REPAIR

A. Repair chips and other surface damage noticeable when viewed in direct daylight at 20 feet.

B. Repair with touchup materials provided by manufacturer in accordance with manufacturer’s instructions.

C. Repair methods and results to be approved by Architect.

3.06 INSPECTION AND ACCEPTANCE

A. Inspect completed installation in accordance with Cast Stone Institute Technical Manual.

3.07 PROTECTION

A. Protect installed cast stone from splashing, stains, mortar, and other damage.
SECTION 05120 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes structural steel.

1.02 DEFINITIONS

A. Structural Steel: Elements of structural-steel frame, as classified by AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.03 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.

1. Select and complete connections using schematic details indicated in AISC 360.
2. Design incorporates Allowable Stress Design (ASD); data is given at service-load level.

B. Moment Connections: Type PR, partially restrained.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show fabrication of structural-steel components.

C. For structural-steel connections indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer and Fabricator.

B. Welding certificates.

C. Mill test reports for structural steel, including chemical and physical properties.

D. Source quality-control reports.

1.06 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or have an equivalent quality assurance program as certified by a qualified independent testing agency.

B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE, or have an equivalent quality assurance program as certified by a qualified independent testing agency.

C. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 360.
3. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.01 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Channels, Angles, Miscellaneous Shapes: ASTM A 36.

D. Plate and Bar: ASTM A 36.

E. Cold-Formed Hollow Structural Sections: ASTM A 500, Grade B, structural tubing.

F. Steel Pipe: ASTM A 53, Type E or S, Grade B.

G. Welding Electrodes: Comply with AWS requirements.

2.02 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436 Type 1, hardened carbon-steel washers; all with plain finish.

1. Direct-Tension Indicators: ASTM F 959, Type 325 compressible-washer type with plain finish.

B. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hexhead assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain.

C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.

D. Unheaded Anchor Rods: ASTM F 1554, Grade 36, or ASTM F 1554, Grade 55, weldable (refer to Structural Steel Notes on drawings for additional information).

2. Finish: Plain.

E. Headed Anchor Rods: ASTM F 1554, Grade 36 or ASTM F 1554, Grade 55, weldable, straight (refer to Structural Steel Notes on drawings for additional information).

1. Finish: Plain.
F. Threaded Rods: ASTM A 36/A 36M.

1. Finish: Plain, or hot-dip zinc coating ASTM A 153, Class C, if exposed to weather.

2.03 PRIMER

A. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Primer: Comply with 09900 “Painting”.

C. Primer: SSPC-Paint 25, Type I, zinc oxide, alkyd, linseed oil primer.

D. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.04 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.05 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC's "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360.

B. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.

2.06 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints
Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened, unless noted otherwise.

B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.07 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:
1. SSPC-SP 3, "Power Tool Cleaning."
2. SSPC-SP6, “Commercial Blast Cleaning” for galvanized surfaces.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

2.08 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123.

B. Galvanize structural steel above the roof and outside the building envelope (exposed to weather).
2.09 SOURCE QUALITY CONTROL

A. Testing Agency: Owner will engage an independent testing and inspecting agency in conjunction with Spec Section 01400 “Quality Control” to perform shop tests and inspections and prepare test reports.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

C. Bolted Connections: Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: In addition to visual inspection, shop-welded connections will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
4. Radiographic Inspection: ASTM E 94.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify, with steel Erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.02 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.


1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.03 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened, unless noted otherwise.

B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
3.04 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency in conjunction with Spec Section 01400 “Quality Control” (Special Inspector, refer to Structural drawings for additional information) to inspect field welds, and, high-strength bolted connections.

B. Bolted Connections: Bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Field welds will be visually inspected according to AWS D1.1.

1. In addition to visual inspection, full penetration field welds will be tested and inspected according to AWS D1.1 and the following inspection procedures, at testing agency's option:

   a. Liquid Penetrant Inspection: ASTM E 165.
   b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   c. Ultrasonic Inspection: ASTM E 164.
   d. Radiographic Inspection: ASTM E 94.

Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

END OF SECTION 05120
SECTION 05210 - STEEL JOIST FRAMING

PART 1 - GENERAL

1.01 SUMMARY
   A. Section Includes:

1.02 ACTION SUBMITTALS
   A. Product Data: For each type of joist, accessory, and product.
   B. Shop Drawings:
      1. Include layout, designation, number, type, location, and spacing of joists.
      2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.

1.03 INFORMATIONAL SUBMITTALS
   A. Welding certificates.
   B. Manufacturer certificates.
   C. Mill Certificates: For each type of bolt.

1.04 QUALITY ASSURANCE
   A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."
1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
   1. Design incorporates Allowable Stress Design (ASD); data is given at service-load level.
   2. Design joists to withstand design loads with live-load deflections no greater than the following:

2.02 K-SERIES STEEL JOISTS

A. Manufacture steel joists of type indicated according to SJI-K-2010 "Standard Specifications for Open Web Steel Joists, K-Series", referred to herein as SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord, unless noted otherwise.

B. Steel Joist Substitutes: Manufacture according to SJI's "Specifications," with steel-angle or -channel members.
2.03 PRIMERS

A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.04 JOIST ACCESSORIES

A. Bridging: Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.

B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

C. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

1. Finish: Plain, uncoated.

D. High-Strength Bolts, Nuts, and Washers: ASTM A 325 Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.

E. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.05 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories.

B. Apply one coat of shop primer.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written recommendations, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.


F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.02 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency in conjunction with Spec
Section 01400 “Quality Control” to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

END OF SECTION 05210
SECTION 05310 - STEEL DECKING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:
   1. Roof deck.
   2. Composite floor deck.

1.02 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.03 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product certificates.

C. Evaluation reports.

D. Field quality-control reports.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

C. Low-Emitting Materials: Paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.02 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Canam United States; Canam Group Inc.
3. New Millennium Building Systems, LLC.
5. Roof Deck, Inc.
7. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 33, G90 zinc coating.
2. Deck Profile: Type WR, wide rib.
3. Profile Depth: 1-1/2 inches.
4. Design Uncoated-Steel Thickness: 0.0358 inch (20 gage).

2.03 COMPOSITE FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Canam United States; Canam Group Inc.
3. New Millennium Building Systems, LLC.
5. Roof Deck, Inc.
7. Wheeling Corrugating Company; Div. of Wheeling-Pittsburgh Steel Corporation.

B. Composite Floor Deck: Fabricate panels, with interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A 653, Structural Steel (SS), Grade 33, G60 (Z180) zinc coating.
2. Profile Depth: 2 inches.
3. Design Uncoated-Steel Thickness: 0.0358 inch (20 gage).
2.04 ACCESSORIES

C. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

D. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

E. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

F. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

G. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0358-inch (20 gage) design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch (14 gage) thick, of same material and finish as deck. For drains, cut holes in the field.


J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
C. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

D. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

E. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

F. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

G. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

H. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and weld.

I. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

J. Pour Stops and Girder Fillers: Weld steel-sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

K. Floor-Deck Closures: Weld steel-sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.
3.02 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency in accordance with Spec Section 01400 “Quality Control” to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.03 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

END OF SECTION 05310
1.01 RELATED DOCUMENTS

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this specification.

1.02 SECTION INCLUDES

A. Work included in this Section consists of furnishing all labor, materials, equipment and incidentals required for complete installation of all load and non-load bearing exterior structural steel studs, interior structural steel studs where indicated and joist framing, fasteners and accessories. Refer to Section 09250 for lightweight metal framing and furring. Refer to Structural Drawings for additional information.

B. Related work specified elsewhere:

1. Section 06100 – Rough Carpentry
2. Section 07420 – Aluminum Composite Metal Wall Panels

1.03 SYSTEM DESCRIPTION

A. Size components to withstand design live and dead loads per design drawings or as follows:

1. Vertical Assembly: Exterior, 30 PSF (wind load) positive or negative; Interior 5 PSF positive or negative.

2. Horizontal Assembly: 40 PSF live load.

B. Maximum allowable deflection: Per Structural Drawings or 1/360 of span.

C. Design wall system to provide for movement of components without damage. Contribution from sheathing shall not be considered for lateral deflection.
D. Design system to accommodate construction tolerances, deflection of building structural members, including metal deck and clearances of intended openings.

1.04 SUBMITTALS

A. Shop Drawings: Indicate component details, framed openings, bearing required, loading, welds, type and location of fasteners and describe framing connections.

B. Provide stud and joist layout.

C. Product Data: Describe materials and finish, product criteria, and limitations.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed cold-formed metal framing similar in material, design, and extent to that indicated for this project and with a record of successful in-service performance, and who is a current member in good standing of the Steel Stud Manufacturer’s Association (SSMA).

B. AISI - American Iron and Steel Institute, Cold-Formed Steel Design Manual.

C. ASTM A446 - Steel Sheet, Zinc Coated (Galvanized) by Hot-Dip Process, Physical (Structural) Quality.

D. ASTM A525 - Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process.

E. ASTM A570 - Hot-Rolled Carbon Steel Sheet and Strip Structural Quality.

F. ASTM A611 - Steel, Cold-Rolled Sheet, Carbon, Structural.

G. ASTM C955 - Load Bearing (Transverse and Axial) Steel Studs, Runners (Track) and Bracing or Bridging, for Screw Application of Gypsum Board and Metal Plaster Bases.

H. AWCI (Association of Wall & Ceiling Industries) - Specification Guide for Cold-Formed Structural Members.
J. AWS D1.3 – Structural welding code – Sheet Steel.
K. SSPC (Steel Structures Painting Council) – Steel Structures Painting Manual.
L. MFMA (Metal Framing Manufacturers Association) – Guidelines for the Use of Metal Framing.

PART 2. PRODUCTS

2.01 FRAMING MATERIALS

A. Manufacturers

1. Clark Dietrich Building Systems
2. Jaimes Industries, Inc.
3. Marino/Ware
4. Other Architect approved current member in good standing of the SSMA.

B. Studs: ASTM A653, sheet steel ‘C’ channel shape, solid web, minimum 18-gage unless noted otherwise; (minimum 16-gage for studs serving as backup for brick veneer), size as noted on drawings, galvanized to G-90 coating class, complying with ASTM C955. Yield strength of 33,000 psi minimum. 22-gage studs are acceptable for interior applications unless noted otherwise.

C. Joists: ASTM A653, Grade 33, sheet steel ‘C’ channel shape, solid web, 18-gage or size as noted on drawings, galvanized to G-90 coating class.

D. Stud Track: Formed steel, channel shaped; same width and gage as stud, solid web, galvanized to G-90 coating class, complying with ASTM C955.

2.02 ACCESSORIES

A. Bracing, Furring, Bridging, Plates, Gussets, Kickers, Stiffeners, Clips: Formed steel, thickness, same as stud or determined for conditions encountered; same finish as framing members.

B. Screws: ASTM A123, hot dip galvanized to 1.25-oz./sq. ft., self-drilling, self-tapping, #10 screws (minimum).
C. Anchorage Devices: Power driven, power actuated or drilled expansion joint as required relative to sub-strata.

D. Welding: In accordance with AWS D1.1 or D1.3.

E. Touch-Up Primer for Galvanized Surfaces: SSPC-Paint 20 with dry film containing minimum of 94 percent zinc dust by weight.

2.03 FABRICATION

A. Fabricate assemblies of sizes and profiles required; with framing members fitted, reinforced and braced.

B. Fit and assemble in largest practical sections for delivery to site, ready for installation.

C. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or distortion.

PART 3. EXECUTION

3.01 EXAMINATION AND PREPARATION

A. Verify that substrate surfaces and building framing components are ready to receive work.

B. Beginning of installation means acceptance of existing conditions and substrate.

3.02 ERECTION OF STUDDING

A. Install components in accordance with manufacturer’s instructions.

B. Align top and bottom tracks; locate to wall layout. Secure with fasteners at maximum 24-inches o.c.

C. Place studs at 16-inches o.c. unless noted otherwise on drawings; not more than 2-inches from abutting walls and at each side of openings. Connect studs to tracks using fastener method. Wire tying of framing members is not permitted.
D. Construct corners using minimum three studs. Double stud each wall opening, door, and window jamb. Install intermediate studs above and below openings to match wall stud spacing.

E. Erect load bearing studs one-piece full length. Splicing of studs is not permitted.

F. Allow for deflection, directly below horizontal building framing, metal decking, etc., for non-load bearing framing.

G. Attach cross studs and furring channels to studs for attachment of fixtures anchored to walls and for attachment of mechanical and electrical items within walls.

H. Touch-up field welds and damaged prefinished surfaces with primer.

I. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

J. Coordinate installation of all wood blocking for installation of items supplied by other trades.

K. Coordinate installation of all framing to accommodate openings required by architectural, mechanical and electrical trades.

3.03 ERECTION OF JOISTS

A. Install components in accordance with manufacturer’s instructions.

B. Make provisions for erection stresses. Provide temporary alignment and bracing.

C. Place joists at 16-inches o.c. unless noted otherwise on drawings; position not more than 2-inches from abutting walls. Connect joists to supports using fastener method. Fasten joists to both flanges of joist track.

D. Set joists parallel with lateral bracing and bridging.

E. Locate joist end bearing directly over load bearing studs or provide load-distributing member to top of stud track.
F. Provide web stiffeners at reaction points.

G. Touch up field welds and damaged prefinished surfaces with primer.

3.04 TOLERANCES

A. Maximum variation from true position: 1/4-inch.

B. Maximum variation of any member from plane: 1/4 inch.

END OF SECTION 05400
PART 1. GENERAL

1.01 RELATED DOCUMENTS

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this specification.

1.02 SECTION INCLUDES

A. Work included in this section consists of furnishing all labor, materials, equipment and incidentals required for complete installation of miscellaneous metal work shown on the drawings, as specified herein, and/or as needed for a complete and proper installation whether shown or not.

B. Related work specified elsewhere:

1. Section 05120 – “Structural Steel Framing”, including all angles, beams, columns, bolts, etc., shown on the structural drawings or required by the architectural drawings.
2. Section 05210 – “Steel Joist Framing”
3. Section 05310 – “Steel Decking”
4. Section 05510 – “Metal Stairs”

1.03 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. Perform shop and/or field welding required in connection with the work of this Section in strict accordance with pertinent recommendations of the American Welding Society.

C. Fabricator Qualifications: Firm experienced in producing metal fabrications similar to those indicated for this project with a record of successful in-service performance, and with sufficient production capacity to produce required units without delaying the work.

1. Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.04 SUBMITTALS

A. Comply with pertinent provisions of Division 1.

B. Product Data: Within 35 calendar days after the contractor has received the Notice of Intent, submit:

1. Shop drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this section with the work of adjacent trades. Provide templates for anchors and bolts specified for installation under other sections.

2. Submit signed and sealed calculations for steel pipe railings by the registered professional engineer registered in the State of Michigan responsible for their preparation.

1.05 PROJECT CONDITIONS

A. Field Measurements: Check Actual locations of walls and other construction to which metal fabrications must fit by accurate field measurements before fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the work.

1. Where field measurements cannot be made without delaying the work, guarantee dimensions and proceed with fabricating products without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

PART 2. PRODUCTS

2.01 MATERIALS

A. In fabricating items which will be exposed to view, limit
materials to those which are free from surface blemishes, pitting, rolled trade names, and roughness.

B. Comply with following standards as pertinent:

1. Steel plates, shapes and bars: ASTM A36.
2. Steel plates to be bent or cold-formed: ASTM A283, Grade C.
3. Steel tubing: ASTM A501, Grade B.
7. Steel pipe: ASTM A53, Grade B, standard weight, black finish unless otherwise noted.
8. For exterior installations and where indicated, provide members with hot-dip galvanizing coat per ASTM A53.
9. Concrete inserts:
   a. Threaded or wedge type galvanized ferrous castings of malleable iron complying with ASTM A27.
   b. Provide required bolts, shims, and washers, hot-dip galvanized in accordance with ASTM A153.

2.02 FASTENERS

A. General:
1. For exterior use and where built into exterior walls, provide zinc-coated fasteners.
2. Provide fasteners of type, grade, and class required for the particular use.

B. Comply with following standards as pertinent:

1. Bolts and nuts: Provide hexagon-head regular type complying with ASTM A307, Grade A.
4. Washers:

2.03 OTHER MATERIALS
A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by contractor subject to the approval of the Architect.

2.04 SHOP PAINT

A. Primer: Use "10-99 Tnemec Primer" or Architect/Engineer equal product by Rustoleum.

B. For repair of galvanizing, use a high zinc-dust content paint complying with SSPC-paint 20. Dry film containing not less than 94 percent zinc dust by weight.

C. Bituminous Paint: Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.

2.05 FABRICATION

A. Except as otherwise shown on the drawings or the approved shop drawings, use materials of size, thickness, and type required to produce reasonable strength and durability in the work of this Section.

B. Fabricate with accurate angles and surfaces which are true to the required lines and levels, grinding exposed welds smooth and flush, forming exposed connections with hairline joints, and using concealed fasteners wherever possible.

C. Prior to shop painting or priming, properly clean metal surfaces as required for the applied finish and for the proposed use of the items.

D. On surfaces inaccessible after assembly or erection, apply two coats of the specified primer. Change color of second coat to distinguish it from the first.

E. Shear and punch metals cleanly and accurately. Remove burrs.

F. Ease exposed edges to a radius of approximately 1/32 inch, unless otherwise indicated. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

G. Shop Assembly: Preassemble items in shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for
reassembly and coordinated installation.

2.06 MISCELLANEOUS METAL FABRICATIONS

A. Rough Hardware:

1. Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels and other miscellaneous steel and iron shapes as required for framing and supporting woodwork and for anchoring or securing woodwork to concrete or other structures. Straight bolts and other stock rough hardware items are specified in Section 06100 “Carpentry”.

2. Manufacture or fabricate items of sizes, shapes, and dimensions required. Furnish malleable iron washers for heads and nuts which bear on wood structural connections; elsewhere, furnish steel washers.

B. Loose Bearing and Leveling Plates:

1. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction made flat, free from warps or twists, and of required thickness and bearing area. Drill plates to receive anchor bolts and for grouting as required. Galvanize after fabrication.

C. Loose Steel Lintels:

1. Provide loose structural steel lintels for opening and recesses in masonry walls and partitions as shown. Weld adjoining members together to form a single unit where indicated. Provide not less than 8” bearing at each side of openings, unless otherwise shown.

2. Size lintels as follows, unless otherwise indicated.
   a. Up to 4’-0” span: One 4” x 3 1/2” x 5/16” steel angle supporting each 4” thick module of masonry.
   b. Spans 4’-0” to 7’-0”: One 5” x 3-1/2” x 5/16” steel angle supporting each 4” thick module of masonry.
   c. Over 7’-0”: Consult Architect if not indicated.

3. Hot dip galvanized loose steel lintels to be installed in exterior walls.
D. Steel Pipe Railings:

1. Provide railings and handrails capable of withstanding the following loads applied as indicated when tested per ASTM E 935.
   a. Concentrated loads of 200 lbs. Applied at any point in any direction.
   b. Uniform load of 50 lbs. Per linear ft. applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.
   d. Infill of Guards:
      Concentrated load of 50 lbs. applied horizontally on an area 1 sq. ft.
      Uniform load of 25 lb./ft. applied horizontally.
      Infill load and other loads need not be assumed to act concurrently.
   e. Provide X-Strong pipe (Schedule 80).

2. Interconnect railing and handrail members by butt-welding or welding with internal connectors, at fabricator’s option.

3. At tee and cross intersections provide coped joints.

4. At bends interconnect pipe by means of prefabricated elbow fittings or flush radius bends, as applicable.

5. Form simple and compound curves by bending pipe in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross-section of pipe throughout entire bend without buckling, twisting or otherwise deforming exposed surfaces of pipe.

6. Provide wall returns at ends of wall-mounted handrails, except where otherwise indicated.

7. Close exposed ends of pipe by welding 3/16” thick steel plate in place or by use of prefabricated fittings.

8. Provide wall brackets, end closures, flanges, miscellaneous fittings and anchors for interconnections of pipe and attachment of railings and handrails to other work. Furnish inserts and other anchorage devices for connecting railings and handrails to concrete or masonry work.

E. Ladders:

1. General: Fabricate ladders for the locations shown, with dimensions, spacings, details, and anchorages as indicated. Comply with requirements of ANSI A14.3. Include safety cages if indicated.

2. Siderails: Continuous, steel, 1/2 x 2-1/2 flat bars, with
4. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.
5. Support each ladder at top and bottom and at intermediate points spaced not more than 60 inches o.c. with welded or bolted steel brackets.
   a. Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 7 inches.
   b. Extend side rails 42 inches above top rung, and return rails to wall or structure unless other secure handholds are provided. If the adjacent structure does not extend above the top rung, goose-neck the extended rails back to the structure to provide secure ladder access.

F. Grating: Fabricate bar grating with depth and bearing bar size as indicated. All edges to be banded.

G. Miscellaneous Framing and Supports:
   1. Provide miscellaneous steel framing and supports as required to complete work.
   2. Fabricate miscellaneous units to sizes, shapes, and profiles shown or, if not shown, or required dimensions to receive adjacent other work to be retained by framing. Except as otherwise shown, fabricate from structural steel shapes, plates, and steel bars of welded construction using metered joints for field connection. Cut, drill and tap units to receive hardware and similar items.
   3. Hot dip galvanize exterior miscellaneous frames and supports.

PART 3. EXECUTION

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

3.02 COORDINATION
   A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for
interface with the work of this Section.

3.03 INSTALLATION

A. General:

1. Set work accurately into position, plumb, level, true and free from rack.
2. Anchor firmly into position.
3. Where field welding is required, comply with AWS recommended procedures of manual-shielded metal-arc welding for appearance and quality of weld and for methods to be used in correcting welding work.
4. Grind exposed welds smooth and touch up shop prime coats.
5. Do not cut, weld, or abrade surfaces which have been hot-dip galvanized after fabrication and which are intended for bolted or screwed field connections.

B. Immediately after erection, clean the field welds, bolted connections and abraded areas of shop priming. Paint the exposed areas with same material used for shop priming.

END OF SECTION 05500
SECTION 05510 - METAL STAIRS

PART 1. GENERAL

1.01 RELATED DOCUMENTS

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this specification.

1.02 PERFORMANCE REQUIREMENTS

A. Structural Performance of Stairs: Provide metal stairs capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft.
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

B. Structural Performance of Railings: Provide railings capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails:
   a. Uniform load of 50 lbf/ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Top Rails of Guards:
   a. Uniform load of 50 lbf/ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

3. Infill of Guards:
   a. Concentrated load of 50 lbf.
   b. Uniform load of 25 lbf/sq. ft. applied horizontally.
   c. Infill load and other loads need not be assumed to act concurrently.

1.03 SECTION INCLUDES

A. Work included in this section consists of furnishing all labor, materials, equipment and incidentals required for complete installation of metal stairs shown on the drawings, as specified herein, and/or as needed for a complete and proper installation whether shown or not.

B. Related work specified elsewhere:

1. Section 05120 – “Structural Steel Framing”; including all angles, beams, columns, bolts, etc., shown on the structural drawings or required by the structural system.
2. Section 05210 – “Steel Joist Framing”
3. Section 05310 – “Steel Decking”
4. Section 05500 – “Metal Fabrications”

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workers who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

1.05 SUBMITTALS

A. Comply with pertinent provisions of Section 01340 “Shop Drawings, Product Data and Samples”.

B. Product Data: Unless noted otherwise in Division 1, General Requirements, within 35 calendar days after the
Contractor has received the Owner’s Notice to Proceed, submit:

1. Materials list of items proposed to be provided under this section.
2. Manufacturer’s specifications and other data needed to prove compliance with the specified requirements.
3. Shop drawings in sufficient detail to show fabrication, installation, anchorage, and interface of the work of this section with the work of adjacent trades.
4. Manufacturer’s recommended installation procedures which, when approved by the Architect/Engineer, will become the basis for accepting or rejecting actual installation procedures used on the work.

PART 2. PRODUCTS

2.01 MATERIALS

A. Comply with following standards as pertinent.

1. Structural Steel: ASTM A500, Grade B and ASTM A36.

2. Metal pans: Form risers and subtreads from 12 gage hot-rolled steel complying with ASTM A526.

3. Sheet Steel: comply with following as appropriate:
   a. Galvanized: ASTM A526 and ASTM A525, coating G90
   b. Landings: Cold-rolled 12 gage steel complying with ASTM A366.

4. Steel Plate:
   a. Except for plates to be bent or cold-formed, comply with ASTM A36.
   b. For plates to be bent or cold-formed, comply with ASTM A283, Grade C.

5. Steel bars and bar-size shapes:
   a. For hot-rolled carbon steel bars and bar-size shapes, comply with ASTM A575 in grade as selected by the fabricator.
   b. For other steel bars and bar-size shapes, comply with ASTM A663 or ASTM A36.

7. Steel pipes:
   a. Comply with ASTM A53, Type E or S, Grade B; or comply with ASTM A120, Schedule 40, unless noted otherwise.
   b. Hot Dip Galvanize where exposed to weather.

8. High-Strength bolts, nuts, and washers: Comply with ASTM A325. Refer to Specification 05120 for additional information.


10. Arc-welding electrodes: Comply with AWS A5.1, using E60XX or E70XX Series as required for the intended use.

11. Handrail brackets: Provide malleable iron or steel standard product units of the type indicated or otherwise required, complete with mounting plates and proper anchoring devices.


2.02 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect/Engineer.

2.03 FABRICATION

A. Shop prefabricate in as large sections as practicable, and in strict accordance with the approved shop drawings and pertinent requirements of governmental agencies having jurisdiction.

B. For members designated as Architecturally Exposed Structural Steel refer to appropriate specification.

C. Pipe railings and handrails: Unless otherwise indicated or approved by the Architect.
   1. Fabricate from 1-1/2” outside diameter steel pipe conforming to Spec Section 05500 2.06D.
D. Priming:

1. Clean surfaces in accordance with Steel Structures painting Council SP-3, “Power Tool Cleaning”.
2. After surfaces are properly cleaned, apply the primer to a uniform 1.5 dry mils thickness.

PART 3. EXECUTION

3.01 SURFACE CONDITION

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

3.02 INSTALLATION

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this section.

B. Install the work of this section in strict accordance with the original design, the approved shop drawings, pertinent requirements of governmental agencies having jurisdiction, and the manufacturer’s recommended installation procedures as approved by the Architect/Engineer, anchoring all components firmly into position for long life under hard use.

C. Pipe railings and handrails: Unless otherwise indicated or approved by the Architect/Engineer:

1. At Hollow walls:
   a. Provide cast brackets having 1-1/2” clearance between railing and wall.
   b. Return handrail ends to within 1/8” of wall.
   c. Secure to wall with approved fasteners.
2. At steel stairs:
   a. Weld railings and newels to stringers.
   b. At top of stairs, continue railings to walls.

D. Upon completion of installation, touch up field welds and abraded surfaces, using primer specified for shop use.
END OF SECTION 05510
1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. The extent of the carpentry work is shown on the Drawings.

1.03 QUALITY ASSURANCE:


B. Factory mark each piece of lumber and plywood with type, grade, mill, and grading agency: West Coast Lumber Assoc. (WBLC) or Western Wood Products Association (WWPA).

1.04 SUBMITTALS:

A. Wood Treatment Data:

1. Submit treatment manufacturer's instructions for proper use of each type of treated material.

   a. Pressure Treatment: For each type specified, include certification by treating plant stating chemicals and process used, net amount of preservative retained, and conformance with applicable standards.

   b. For water-borne preservatives, include statement that moisture content of treated materials was reduced to a maximum of 15% prior to shipment to project site.

B. Product Data:

1. Submit manufacturer's specifications and other data for each carpentry anchorage, fastening, and miscellaneous material. Provide material certificates for all lumber and plywood. Transmit a copy of each instruction to the Installer.
1.05 PRODUCT HANDLING:
   A. Delivery and Storage: Keep materials dry during delivery and storage. Protect against exposure to weather and contact with damp or wet surfaces. Stack lumber and plywood and provide air circulation within stacks.

1.06 JOB CONDITIONS:
   A. Coordination: Fit carpentry work to other work, scribe and cope as required for accurate fit. Correlate location of furring, nailers, blocking, grounds, and similar supports to allow proper attachment of other work.

PART 2 – PRODUCTS

2.01 MATERIALS:
   A. Lumber - General:
      1. Nominal sizes are indicated, except as shown by detail dimensions. Provide actual sizes as required by PS 20-05, for the moisture content specified for each use. Use dressed lumber, surfaced four sides (SFS) seasoned with 19% maximum moisture content at time of dressing.

   B. Framing Lumber (2" through 4" thick):
      1. For light framing (less than 6" wide), provide Construction Grade Douglas Fir as graded by the West Coast Lumber Bureau (WCLB) or equivalent species and grade with minimum fiber stress rating (bending) of 1000 psi (Fb), and modules of elasticity of 1,500,000 psi.

      2. For structural framing (6" and wider and from 2" to 4" thick) provide dense No. 1 Grade Douglas Fir as graded by the West Coast Lumber Bureau (WCLB) or equivalent species and grade with minimum fiber stress rating (bending) of 1500 psi (Fb), and modules of elasticity of 1,700,000 psi.

   C. Boards (less than 2" thick):
      1. Produce lumber of 19% maximum moisture content (S-DRY) and of the following species and grade.
         a. Redwood Construction Common (RIS).
         b. Southern Pine No. 2 Boards (SPIB).
         c. Or any species graded construction Boards (WCLB or WWPA).
D. Plywood:

1. Provide only Douglas Fir Plywood in accordance with grading requirements of the APA - The Engineered Wood Association as follows:
   a. Treated non-combustible AC standard with exterior glue.

E. Anchorage and fastening Materials:

1. Select proper type, size, material, and finish for each application. Comply with the following:
   b. Wood Screws: FS FF-S-111.
   c. Bolts and Studs: FS FF-B-575.
   f. Lag Screws or Lag Bolts: FS FF-B-561.
   g. Masonry Anchoring Devices: For expansion shields, nails, and drive screws, comply with FS FF-S-325.
   h. Toggle Bolts: FS FF-B-588.
   i. Bar or Strap Anchors: ASTM A 575 carbon steel bars.

2.02 WOOD TREATMENT:

A. Preservation Treatment: Where lumber or plywood is indicated as "Treated" or is specified herein to be treated, comply with the applicable requirements of the American Wood Preservers Association (AWPA) AWPA P23-08, ASTM D-1625 and Federal Specification TT-W-50.

B. Pressure-treat above-ground items with water-borne preservatives complying with AWPA P5-09, ASTM D-1760, and Federal Specification TT-W-571. After treatment, kiln-dry to a maximum moisture content of 19%. Treat indicated items and the following, except where fire retardant treated.
1. Wood cants, nailers, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers and waterproofing.

2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

3. Wood framing members less than 12 inches above grade excepting timber.

C. Fire Retardant Treated:

1. Wood blocking and similar items installed within the building shall be pressure impregnation with retardant chemicals to achieve a flame spread rating of not more than 25 when tested in accordance with UL Test 723, ASTM E 84, or NFPA Test 355.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Installer must examine the substrates and supporting structure and the conditions under which the carpentry work is to be installed and notify the General Contractor, in writing, of conditions detrimental to the work. Do not proceed with the installation until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.02 INSTALLATION:

A. General:

1. Discard units of material with defects which might impair the quality of the work, and units which are too small to fabricate the work with minimum joints or the optimum joint arrangement.

2. Set carpentry work accurately to required levels and lines, with members plumb and true and accurately cut and fitted.

3. Securely attach carpentry work to substrate by anchoring and fastening as shown and as required. Provide washers under bolt heads and nuts in contact with wood. Nail plywood in accordance with the recommendations of APA-The Engineered Wood Association.
4. Use common wire nails, except as otherwise shown or specified herein. Use finishing nails for exposed work. Do not wax of lubricate fasteners that depend on friction for holding power. Select fasteners of size that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting of wood; pre-drill as required. Do not drive threaded friction type fasteners; turn into place. Tighten bolts and lag screws at installation and retighten as required for tight connections prior to closing in or at completion of work.

B. Wood Grounds, Nailers, Blocking and Sleepers:

1. Provide wherever shown and where required for screening or attachment of other work. Form to shapes as shown and cut as required for true line and level of work to be attached. Coordinate location with other work involved.

2. Attach to substrates as required to support applied loading. Countersink bolts and nuts flush with surfaces, unless otherwise shown. Build into masonry during installation of masonry work. Where possible, anchor to form work before concrete placement.

3. Provide permanent grounds of dressed, pressure preservative treated key-bevelled lumber not less than 1-1/2" wide and of the thickness required to bring face of ground to exact thickness of finished material involved. Remove temporary grounds when no longer required.

C. Wood Furring:

1. Install plumb and level with closure strips at all edges and openings. Shim with wood as required for tolerance of finished work.

D. Wood Framing:

1. Provide framing members of sizes and on spacings shown and frame openings as shown, or if not shown, comply with recommendations of "The Wood Frame Construction Manual" 2001 Ed. of the American Wood Council. Do not splice structural members between supports.
2. Anchor and nail as shown, and comply with the "Recommended Nailing Schedule - Table I of the Manual for Housing Framing: and other recommendations of the N.F.P.A.

E. Installation of Plywood:

1. Comply with recommendations of the Engineered Wood Association (APA) for the installation of plywood.

END OF SECTION 06100
SECTION 06402 - INTERIOR ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior standing and running trim and rails, including wood door frames.
2. Plastic laminate countertops/reception desks (not associated with pre-manufactured cabinets).
3. Interior miscellaneous ornamental items.
4. Custom cabinetry (laminate clad millwork)
5. Laminated wood paneling.
6. Hardware schedule for new custom cabinets.

B. Related Sections: The following sections contain requirements that relate to this section:

1. Division 6 Section 06100 "Carpentry" for furring, blocking, and other carpentry work that is not exposed to view.
2. Division 8 Section 08210 "Flush Wood Doors" for doors specified by reference to architectural woodwork standards.
3. Division 9 Section 09900 "Painting" for final finishing of installed architectural woodwork.
4. Division 12 Section 12300 “Plastic Laminate Casework”.

1.3 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.
B. Product data for each type of product and process specified in this section and incorporated into items of architectural woodwork during fabrication, finishing, and installation.

C. Fire-retardant treatment data for material impregnated by pressure process to reduce combustibility. Include certification by treating plant that treated materials comply with requirements.

D. Shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Plastic laminate.
2. Factory-applied opaque finishes.

E. Samples for verification purposes of the following:

1. Lumber with or for transparent finish, 50 square inches, for each species and cut, finished on one side and one edge.

2. Veneer leaves representative of and selected from flitches to be used for transparent finished woodwork.

3. Wood veneer faced panel products; with or for transparent finish, 8-1/2 inches by 11 inches, for each species and cut with one half of exposed surface finished, with separate samples of unfaced panel product used for core.

4. Lumber and panel products with factory-applied opaque finish, 8-1/2 inches by 11 inches for panels and 50 square inches for lumber, for each finish system and color, with one half of exposed surface finished.

5. Laminate clad panel products, 8-1/2 inches, by 11 inches for each type, color, pattern, and surface finish, with separate samples of unfaced panel product used for core.

6. Corner pieces as follows:
   a. Cabinet front frame joints between stiles and rail as well as exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
   b. Miter joints for standing trim.
7. Exposed cabinet hardware, one unit of each type and finish.

F. Product certificates signed by woodwork manufacturer certifying that products comply with specified requirements.

G. Qualification data for firms and persons specified in "Quality Assurance" article to demonstrate their capabilities and experience. Include list of completed projects with project names, addresses, names of Architects and Owners, and other information specified.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Firm experienced in successfully producing architectural woodwork similar to that indicated for this Project, with sufficient production capacity to produce required units without causing delay in the Work.

B. Single-Source Responsibility: Arrange for production by a single firm of architectural woodwork with sequence matched wood veneers.

C. Single-Source Manufacturing and Installation Responsibility: Engage a qualified Manufacturer to assume undivided responsibility for woodwork specified in this section, including fabrication, finishing, and installation.

D. Installer Qualifications: Arrange for installation of architectural woodwork by a firm that can demonstrate successful experience in installing architectural woodwork items similar in type and quality to those required for this project.

E. AWI Quality Standard: Comply with applicable requirements of "Architectural Woodwork Quality Standards" published by the Architectural Woodwork Institute (AWI) except as otherwise indicated.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.
B. Do not deliver woodwork until painting, wet work, grinding, and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Obtain and comply with Woodwork Manufacturer's and Installer's coordinated advice for optimum temperature and humidity conditions for woodwork during its storage and installation. Do not install woodwork until these conditions have been attained and stabilized so that woodwork is within plus or minus 1.0 percent of optimum moisture content from date of installation through remainder of construction period.

B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before manufacturing woodwork; show recorded measurements on final shop drawings. Coordinate manufacturing schedule with construction progress to avoid delay of Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with manufacture of woodwork without field measurements. Coordinate other construction to ensure that actual dimensions correspond to guaranteed dimensions.

PART 2 - PRODUCTS

2.1 HIGH PRESSURE DECORATIVE LAMINATE MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering high pressure decorative laminates which may be incorporated in the work include but are not limited to the following:

B. Manufacturer: Subject to compliance with requirements, provide high pressure decorative laminates of one of the following:

1. Formica Corp.
2. Laminart.
3. Nevamar Corp.
4. Wilsonart International
5. Arborite – Div. of ITW Canada
2.2 MATERIALS

A. General: Provide materials that comply with requirements of the AWI woodworking standard for each type of woodwork and quality grade indicated and, where the following products are part of woodwork, with requirements of the referenced product standards, that apply to product characteristics indicated:

1. Hardboard: ANSI/AHA A135.4


4. Particleboard: ANSI A208.1


6. Formaldehyde Emission Levels: Comply with formaldehyde emission requirements of each voluntary standard referenced below:
   c. Hardwood Plywood: HPMA FE.

B. Fire-Retardant Particleboard: Where indicated, provide panels complying with the following requirements that have fire-retardant chemicals bonded to softwood particles at time of panel manufacture to achieve products identical to those tested for flame spread of 20 or less and for smoke developed of 25 or less per ASTM E 84 by UL or other testing and inspecting organization acceptable to authorities having jurisdiction. Identify products with appropriate markings of applicable testing and inspecting organization.

1. For 45-lb-density panels and thicknesses of 3/4 inch and less, comply with ANSI A208.1 for Grade 1-M-1 except that minimums for modulus of elasticity and screw-holding capacity on face and edge shall be 300,000 psi, 250 lb, and 225 lb, respectively.
2. For 44-lb-density panels and thicknesses of 13/16 inch to 1-1/4 inch, comply with ANSI A208.1 for Grade 1-M-1 except that minimums for modulus of rupture, modulus of elasticity, internal bond, linear expansion, and screw-holding capacity on face and edge shall be 1300 psi, 250,000 psi, 60 psi, 0.50 percent, 250 lb, and 175 lb, respectively.

3. Product: Subject to compliance with requirements, provide "Duraflake FR" by Duraflake Div.; Willamette Industries, Inc.

2.3 FABRICATION, GENERAL

A. Wood Moisture Content: Comply with requirements of referenced quality standard for moisture content of lumber in relation to relative humidity conditions existing during time of fabrication and in installation areas.

B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:

1. Corners of cabinets and edges of solid wood (lumber) members less than 1 inch in nominal thickness: 1/16 inch.

2. Edges of rails and similar members more than 1 inch in nominal thickness: 1/8 inch.

C. Complete fabrication, including assembly, finishing, and hardware application, before shipment to project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

D. Factory-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges of cutouts with a water-resistant coating.
2.4 FIRE-RETARDANT-TREATED LUMBER

A. Low-Hygroscopic Formulation: Interior Type A per AWPA C20.

B. Fire Performance Characteristics: Provide materials identical to those tested for the following fire performance characteristics per ASTM test methods indicated by UL or other testing and inspecting organizations acceptable to authorities having jurisdiction. Identify treated lumber with classification marking of inspecting and testing organization in the form of separable paper label or, where required by authorities having jurisdiction, of imprint on lumber surfaces that will be concealed from view after installation.

1. Surface Burning Characteristics: Not exceeding values indicated below, tested per ASTM E 84 for 30 minutes with no evidence of significant combustion.
   b. Smoke Developed: 50.

C. Mill lumber after treatment, within limits set for wood removal that does not affect listed fire performance characteristics, using a woodworking plant certified by testing and inspecting organization.

D. Kiln-dry woodwork after treatment to levels required for untreated woodwork. Maintain moisture content required by kiln drying before and after treatment.

E. Discard treated lumber that does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective lumber.

F. Available Products: Subject to compliance with requirements, products that may be incorporated in the work include but are not limited to the following:
   2. Osmose Wood Preserving, Inc.

2.5 STANDING AND RUNNING TRIM AND RAILS FOR TRANSPARENT FINISH

A. Quality Standard: Comply with AWI Section 300.
B. Backout or groove backs of flat trim members and kerf backs of other wide flat members, except for members with ends exposed in finished work.

C. Assemble casings in plant except where limitations of access to place of installation require field assembly.

D. Grade: Premium.

E. Lumber Species:
   1. Red oak, rift sawn.

F. Lumber Species: Match species and cut indicated for other types of transparent finished architectural woodwork located in same area of building unless otherwise indicated.
   1. Provide split species on trim that face areas with different wood species, matching each face of woodwork to species and cut of finish wood surfaces in areas finished.

2.6 STANDING AND RUNNING TRIM AND RAILS FOR OPAQUE FINISH

A. Quality Standard: Comply with AWI Section 300.

B. Grade: Custom.

C. Backout or groove backs of flat trim members and kerf backs of other wide flat members, except for members with ends exposed in finished work.

D. Assemble casings in plant except where limitations of access to place of installation require field assembly.

E. Lumber Species: Red Oak.

2.7 ARCHITECTURAL CABINET TOPS (PLASTIC LAMINATE COUNTERTOPS)

A. Quality Standard: Comply with AWI Section 400 and its Division 400C.

B. Type of Top: High pressure decorative laminate complying with the following:
   1. Grade: Custom.

   2. Laminate Cladding for Horizontal Surface: High pressure decorative laminate as follows:
a. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1) Match Architect's sample.

3. Edge Treatment: As indicated.

C. Fire Performance Characteristics: Provide paneling composed of panels of wood veneer density and fire-retardant particleboard that are identical in construction to units tested for the following surface burning characteristics per ASTM E 84 by UL or other testing and inspecting organization acceptable to authorities having jurisdiction. Identify panels with appropriate markings of applicable testing and inspecting organization on surfaces that will be concealed from view after installation.

1. Flame Spread: 75 or less.
2. Smoke Developed: 40 or less.

2.8 INTERIOR MISCELLANEOUS ORNAMENTAL ITEMS FOR TRANSPARENT FINISH

A. Quality Standard: Comply with AWI Section 700.

B. Grade: Premium

C. Lumber Species:
   1. Red Oak rift sawn

2.9 INTERIOR MISCELLANEOUS ORNAMENTAL ITEMS FOR OPAQUE FINISH

A. Quality Standard: Comply with AWI Section 700.

B. Grade: Custom.

C. Lumber Species: Eastern white pine, sugar pine, or Idaho white pine.

2.10 CUSTOM CABINETRY (LAMINATE CLAD MILLWORK)

A. Quality Standard: Comply with AWI Section 400 and its Division 400B "Laminate Clad Cabinets."

B. Grade: Custom.
C. AWI Type of Cabinet Construction: As indicated.
D. Laminate Cladding: High pressure decorative laminate complying with the following requirements: (provide fire-rated laminate where indicated on the documents).

1. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   a. Provide selections made by Architect from laminate manufacturer's full range of standard colors and finishes in the following categories:
      1) Solid colors.
      2) Patterns.

2. Laminate Grade for Exposed Surfaces: Provide laminate cladding complying with the following requirements for type of surface and grade:
   a. Horizontal Surfaces Other Than Tops: GP-50 (0.050-inch nominal thickness).
   b. Postformed Surfaces: PF-42 (0.042-inch nominal thickness).
   c. Vertical Surfaces: GP-50 (0.050-inch nominal thickness).
   d. Vertical Surfaces: GP-50 (0.050-inch nominal thickness).

3. Semiexposed Surfaces: Provide surface materials indicated below:

E. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers except where located directly under tops.

2.11 LAMINATED PANELING

A. Provide Lamin-Art high pressure decorative laminate (in wood grain pattern) as shown on drawings and as specified.
   1. Manufacturer: Lamin-Art, Inc. Schaumburg, IL, 1-800-323-7624.

C. Submittals: Provide (4) 2” x 3” size samples of manufacturer’s standard wood grain patterns and (4) copies of manufacturer’s product data sheet and installation specification for review.

D. Deliver, store and handle product per manufacturer’s specifications. Store horizontally with the top face down and a call board placed on top to protect materials from damage and from warping. Protect laminate from moisture and from contact with floors or outside walls. Allow laminate and substrate to acclimate to site for at least 72 hours at the same ambient conditions. Optimum conditions are approximately 75°F and relative humidity of 45% to 55%. Provide air circulation around product.

E. Materials
1. Pattern number and name shall be selected by the Architect from the manufacturer’s full range of wood grain patterns.
2. Grade: Standard grade GP48 (.048”).
4. Edge: Provide miter fold edge.
5. Laminate to ¼” medium density fiberboard (MDF).
   a. Provide adhesives and process per manufacturer’s specifications.
   b. Provide with a suitable backing sheet for balanced assembly.

F. Install finished product as indicated on drawings.
2. Clean laminate with warm water and a mild soap or household cleaners approved by manufacturer.

2.12 FASTENERS AND ANCHORS

A. Screws: Select material, type, size, and finish required for each use. Comply with FS FF-S-111 for applicable requirements.
   1. For metal framing supports, provide screws as recommended by metal framing manufacturer.

B. Nails: Select material, type, size, and finish required for each use. Comply with FS FF-N-105 for applicable requirements.
C. Anchors: Select material, type, size, and finish required by each substrate for secure anchorage. Provide nonferrous metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts and anchors, as required, to be set into concrete or masonry work for subsequent woodwork anchorage.

2.13 FACTORY FINISHING OF INTERIOR ARCHITECTURAL WOODWORK

A. Quality Standard: Comply with AWI Section 1500 unless otherwise indicated.

B. General: The primary and prefinishing (if any) of interior architectural woodwork required to be performed at factory is specified in this section. Refer to Division 9 Section "Painting" for final finishing of installed architectural woodwork and for material and application requirements of prime coats for woodwork not specified to receive final finish in this section.

C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces and similar preparations for finishing of architectural woodwork, as applicable to each unit of work.

D. Transparent Finish for Open-Grain Woods: Comply with requirements indicated below for grade, finish system, staining, effect, and sheen, with sheen measured on 60 deg gloss meter per ASTM D 523.

1. Grade: Premium.

2. AWI Finish System #1: Standard lacquer.


4. Effect: Closed grain (filled finish).

5. Sheen: Medium-gloss rubbed effect 35-45 deg.
E. Transparent Finish for Closed-Grain Woods: Comply with requirements indicated below for grade, finish system, staining, effect, and sheen.

1. Grade: Premium.
2. AWI Finish System #1: Standard lacquer.
4. Effect: Closed grain.
5. Sheen: Medium-gloss rubbed effect 35-45 deg.

F. Opaque Finish: Comply with requirements indicated below for grade, finish system, color, effect, and sheen:

1. Grade: Custom.
2. AWI Finish System #9: Standard lacquer.

PART 3 - EXECUTION

3.1 PREPARATION

A. Condition woodwork to average prevailing humidity conditions in installation areas before installing.

B. Deliver concrete inserts and similar anchoring devices to be built into substrates well in advance of time substrates are to be built.

C. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including back priming and removal of packing.

3.2 INSTALLATION

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for same grade specified in Part 2 of this section for type of woodwork involved.
B. Install woodwork plumb, level, true, and straight with no distortions. Shim as required with concealed shims. Install to a tolerance of 1/8 inch in 8'-0" for plumb and level (including tops) and with no variations in flushness of adjoining surfaces.

C. Scribe and cut woodwork to fit adjoining work and refinish cut surfaces or repair damaged finish at cuts.

D. Fire-Retardant-Treated Wood: Handle, store, and install fire-retardant-treated wood to comply with recommendations of chemical treatment manufacturer including those for adhesives where are used to install woodwork.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure to grounds, stripping and blocking with countersunk, concealed fasteners and blind nailing as required for a complete installation. Except where prefinished matching fastener heads are required, use fine finishing nails for exposed nailing, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

F. Standing and Running Trim and Rails: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to the greatest extent possible. Stagger joints in adjacent and related members. Cope at returns and miter at corners.

G. Tops: Anchor securely to base units and other support systems as indicated.

H. Complete the finishing work specified in this section to whatever extent not completed at shop or before installation of woodwork.

I. Refer to the Division 9 sections for final finishing of installed architectural woodwork.

3.3 ADJUSTMENT AND CLEANING

A. Repair damaged and defective woodwork where possible to eliminate defects functionally and visually; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.
C. Clean woodwork on exposed and semiexposed surfaces. Touch up factory-applied finishes to restore damaged or soiled areas.

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensures that woodwork is being without damage or deterioration at time of Substantial Completion.

3.5 HARDWARE SCHEDULE

A. Drawer slide (Precision single extension) No. 8300 Truc-Trac.

B. Wire Pulls: #FE14896-26D (96mm c/c) Finish: dull chrome, by Essential Designs.

C. Locks: TLCB250 by Timberline with Masterkey and all associated accessories for mounting.

D. Grommets: Mockett 3” o.d. Black: MQEDP3BK with flip top tab

E. Keyboard Slide & Tray: Knape & Vogt KV SRS with platform (BBP1824).

F. Casters: 4” diameter, Swivel, heavy duty caster with brake.

END OF SECTION 06402
1.01 RELATED DOCUMENTS

A. Attention is directed to Division 0, Bidding and Contract Requirements and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. The extent of surfaces to receive bituminous dampproofing is as noted below and shown on the drawings.

B. Apply to exterior side of CMU foundations below grade at all perimeter walls of building.

C. Related Work Specified Elsewhere:
   1. Section 07200 - Perimeter Insulation

1.03 SUBMITTALS

A. Product Data:

   1. Submit 2 copies of manufacturer's specifications, installation instructions and general recommendations for required dampproofing material. Include manufacturer's certification to other data substantiating that the materials comply with the requirements, and are recommended by the manufacturer for the application shown or specified. Indicate by copy of transmittal form that the Installer has received a copy of the instructions and recommendations.

1.04 JOB CONDITIONS:

A. Do not proceed with dampproofing work until blocking, nailers, piping, conduit and other projections through the substrate have been installed, with substrate properly patched and sealed or flashed to receive the dampproofing.

B. When ambient temperature is 40 degrees F or less and falling, do not proceed with dampproofing. Do not
apply dampproofing materials to frozen substrate or to any substrate in a condition not complying with manufacturer's recommendations.

C. The Installer must examine the substrates and the conditions under which the dampproofing is to be applied and advise the General Contractor in writing of unsatisfactory conditions. Do not proceed with the dampproofing work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Asphalt Compound: Manufacturer's standard asphalt and solvent compound recommended for above-grade interior applications, compounded to penetrate substrate and build to a moisture-resistant, vapor-resistant, firm elastic coating.


B. Cold-Applied, Asphalt Emulsion Dampproofing: Asphalt-based emulsions recommended by the manufacturers for dampproofing use when applied according to the manufacturer's instructions and as follows:

1. Trowel Grade: Emulsified asphalt mastic, prepared with mineral-colloid emulsified agents and containing fibers other than asbestos, complying with ASTM D 1227, Type III or IV.

C. Primer: Asphalt primer complying with ASTM D 41, for asphalt based dampproofing.

D. Rigid protective boards shall be 1/8 inch thick similar to "Protective Course II" material by Sonneborn. Provide protective boards where perimeter insulation is not used.

E. Odor Elimination For interior and concealed-in-wall uses, provide type of bituminous dampproofing material which is warranted by manufacturer to be substantially odor-free after drying for 24 hours under normal conditions.

PART 3 - EXECUTION
3.01 PREPARATION OF SUBSTRATE

A. Clean the substrate of dirt, oil, loose materials and other substances which interfere with penetration, bond or performance of dampproofing materials.

B. Prime substrate, except where specifically recommended by manufacturer of dampproofing compound to omit primer; apply type recommended by manufacturer, at rate recommended for condition of substrate.

3.02 INSTALLATION

A. Apply coating material in accordance with the manufacturer's printed instructions using sufficient quantity to form a continuous unbroken coating over surfaces to be dampproofed. Retouch surfaces as necessary to provide a continuous coating. Protect adjacent surfaces from damage by the dampproofing. Material applied with trowel shall have at least 1/8 inch thickness.

B. Apply mastic in one coat directly from the container without thinning. Form a cove at the corner junction of surfaces which are coated. Joints, grooved, slots, or breaks in the surfaces shall be completely and continuously covered. Spread coating into chases, corners, reveals, or other surfaces which occur below grade. Reinforce at corners and angles with one additional thickness of membrane.

C. Apply vertical dampproofing down walls to top of footing, but do not extend onto surfaces exposed to view when the Project is completed.

3.03 COLD-APPLIED, ASPHALT EMULSION DAMPPROOFING

A. Trowel Grade: Trowel apply a coat of mastic asphalt emulsion dampproofing onto substrate a minimum rate of 7 gal./100 sq. ft. to produce an average, dry-film thickness of 60 mils, but not less than 30 mils at any point.

3.04 PROTECTION
A. After the mastic has set and solvents have left the mixture, apply protective board layer over the entire surface of the mastic, holding in place with spots of additional mastic, where wall will not be covered with perimeter insulation.

END OF SECTION 07160
PART 1. GENERAL

1.01 RELATED DOCUMENTS
A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this specification.

1.02 SECTION INCLUDES
A. Work included in this Section consists of furnishing all labor, materials, equipment and incidentals required for complete installation of water repellent coatings including clear sealer and all associated accessories mentioned or scheduled on the drawings and/or herein.

1.03 RELATED WORK SPECIFIED ELSEWHERE
A. Section 04100 – Mortar and Grout
B. Section 04300 – Unit Masonry
C. Section 04720 – Cast Stone
D. Section 07920 – Sealants and Caulking

1.04 SYSTEM DESCRIPTION
A. The exterior coating system shall consist of a liquid-applied, one or two application clear natural looking water repellent sealer.

1.05 QUALITY ASSURANCE
A. Installation: Applicator of water repellent coating system shall be certified by the manufacturer. Copy of certification shall be submitted with shop drawings.

B. Application: Test a small area of surface before starting general application to assure desired results and coverage rates. Clear Sealer shall be applied in accordance with manufacturer's written instructions. Apply sealer in two coats with use of recommended spray equipment.
1.06 WARRANTY REQUIREMENTS

A. Provide ten year warranty under provisions of Division 1, ensuring the water repellent performance of the system from date of acceptance. Provisions of the warranty shall include responsibility for water penetration through peeling and flaking of the coating film.

1.07 SUBMITTALS

A. Refer to Division 1, General Requirements, for submission procedures.

B. Submit two samples of masonry units with finished product applied. Masonry shall be from actual units for use on this project. Examination of samples will be for color change only.

C. Provide eight (8) copies of manufacturer's product data including installation/application instructions.

1.08 PRODUCT HANDLING

A. Materials shall be delivered to site in original manufacturer's sealed containers.

B. Materials shall be stored off the ground and in such a manner as to prevent any damage to containers and protect from freezing temperatures.

C. Sealer shall be thoroughly stirred before and occasionally during use per manufacturer's written instructions.

1.09 ENVIRONMENTAL REQUIREMENTS

A. Maintain temperatures above 50°F. 24 hours prior to application and continuously until sealer has completely dried.

B. Do not apply sealer if rain is expected within 24 hours of application.

PART 2. PRODUCTS

WATER REPELLENT COATINGS 07175-2
2.01 MATERIALS

A. Manufacturers:
   2. Tamms Industries Co., Chemstop Regular.
   3. Rainguard – Blok Lok RTU – Penetrating Water Repellant
   4. Other architect approved.

B. Coatings: Ready mixed, of good flow, spray and brushing properties, capable of drying or curing free of streaks or sags. Materials shall be resistant to fade and efflorescence.

C. Finish: Natural looking, non-textured, clear.

PART 3. EXECUTION

3.01 EXAMINATION & PREPARATION

A. Verify that substrate conditions and related work performed under other sections are acceptable for installation of work by this trade. Notify Construction Manager in writing of substrate conditions not acceptable for proper application of water repellent coating system.

B. Loose mortar shall be repointed.

C. Efflorescence shall be cleaned from surface and neutralized with product compatible with water repellent coating system.

D. Concrete/masonry shall be dry; mortar and caulking fully cured prior to application.

E. Mask all areas and items adjacent to areas to be coated, including aluminum, wood, glass, shrubs, topsoil and horizontal concrete.

3.02 APPLICATION

A. Clear Sealer:
   1. Surface receiving sealer must be dry per recommendations of sealer manufacturer.
   2. Apply sealer by flooding the surface using manufacturer
approved equipment and techniques. Allow excess material to run down a minimum of 12 inches. Follow-up brushing or rolling shall be performed when required by the manufacturer.

3. If required by the manufacturer per conditions encountered, apply second coat 24 hours after the first coat at normal drying conditions.

4. Coverage rates shall be manufacturer's required rates for split face CMU.

3.03 CLEANING

A. Remove masking from all areas. Mop up puddles from all horizontal surfaces prior to removing masking; do not allow material to runoff masking onto adjacent surfaces.

B. Clean all areas of splash or overspray per manufacturer's written instructions. Under no circumstances shall product be allowed to dry on surfaces not scheduled to receive the water repellent coating system.

C. Promptly remove and properly dispose of all empty containers, masking and disposable applicators. Remove all equipment and staging as soon as practicable from job site.

3.04 SCHEDULE

A. All exterior split face CMU and cast stone.

B. All exposed poured concrete, including retaining walls and other vertical concrete surfaces (do not apply to flat concrete work; i.e. walks and slabs).

END OF SECTION 07175
PART 1 - GENERAL

1.01 RELATED DOCUMENTS:
   A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:
   A. The extent of thermal insulation work is shown on the drawings.

   B. The applications of thermal insulation specified in this section include the following:
      1. Cavity wall.
      2. Board-type building insulation.

   C. Related Work Specified Elsewhere:
      1. Section 07500 – Roof Insulation for Membrane Roofing System.
      2. Division 15, Mechanical: Insulation for ducts, heating, air conditioning, ventilating, and plumbing work shall be furnished and installed by the respective Mechanical Contractor.
      3. Division 16, Electrical: Insulation for electrical work shall be furnished and installed by Electrical Contractor.

1.03 QUALITY ASSURANCE:
   A. Thermal Conductivity: The thickness shown are for the thermal conductivity (k-value at 75%) specified for each material. Provide adjusted thicknesses as directed for the equivalent use of material having a different thermal conductivity.

   B. Fire Ratings: Comply with the fire-resistance and flammability ratings indicated, and comply with governing regulations as interpreted by authorities including:
      1. UL requirements for "Roof Deck Constructions" which are rated "Fire-Acceptable".
1.04 SUBMITTALS:

A. Product Data:

1. Submit manufacturer's specifications and installation instructions for each type of insulation required. Include data substantiating that materials comply with specified requirements.

B. Shop Drawings:

1. Submit shop drawings for tapered roof area. Show all slopes, thickness, perimeter and roof sump conditions.

1.05 PRODUCT HANDLING:

A. Protection from Deterioration: Do not allow insulation materials to become wet, soiled, or covered with ice or snow. Comply with manufacturer's recommendations for handling, storage and protection during installation. Protect plastic insulation from exposure to sunlight.

B. Fire Hazard: Do not deliver plastic insulating materials to the project site ahead of installation time. Protect at all times against ignition. Complete installation and concealment of plastic materials as rapidly as possible in each area of work.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Extruded Polystyrene Plastic Board Insulation:

1. Cavity Wall Insulation
   a. Material Properties
      1. Rigid closed-cell, polystyrene thermal board insulation.
      3. Thermal resistance: 5-year aged R-values of 5.4 and 5.0 min. °F-ft2-h/Btu2/inch a 40°F and 75°F respectively (ASTM C 518-91).
      4. Water absorption: Max. 0.1% by volume (ASTM C 272-91 (96)).
5. Surface Burning Characteristics:
   i. Flame Spread: 5
   ii. Smoke Developed: 165
b. Thickness: 2” (R-10)
c. Acceptable manufacturer’s product: The Dow Chemical Company “STYROFOAM® Brand CAVITYMATE®.”

2. Perimeter Edge Insulation
   a. Material Properties:
      1. Rigid closed-cell extruded polystyrene thermal board insulation.
      2. Comply with ASTM C 578-92, Type VI, density 1.8 lb/cu. Ft. min., compressive strength 40 psi (STM D 1621-73).
      3. Thermal resistance: 5-year aged R-values of 5.4 and 5.0 min. °F-ft2-h/Btu2/inch at 40°F and 75°F respectively (ASTM C 518-91).
      4. Water absorption: Max 0.3% by volume (ASTM C 272-91).
   b. Thickness: 2” unless otherwise indicated.
c. Acceptable manufacturer’s product: Dow Chemical Company “STYROFOAM® Brand High Load (HI-40)” material.

B. Mineral/Glass Fiber Blanket/Batt Insulation:
   1. Unfaced Mineral Fiber Blanket/Batt Insulation: Thermal insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C665 for type described below with thermosetting resins to comply with ASTM C665 for Type 1 (blankets without membrane facing); and as follows:
      a. Mineral Fiber Type: Fibers manufactured from glass.
      b. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50, respectively.
   2. Miscellaneous Insulation: Shall be inorganic (nonasbestos) mineral wool insulation without facing, for the purpose of filling and stuffing openings in walls around pipes, structural components, windows, conduits, expansion joints to eliminate noise transfer and to insulate. Use to seal top of interior walls, except fire rated walls, between masonry and roof deck, where indicated. Use at expansion joints as detailed. Insulation shall have a flame spread rating of 15 or less, and a smoke development rating of 0; per ASTM E84.

2.02 AUXILIARY INSULATING MATERIALS
A. Adhesively Attached, Spindle-Type Anchors: Plate welded to projecting spindle; capable of holding insulation of thickness indicated, securely in position indicated with self-locking washer in place; and complying with the following requirements:

1. **Plate:** Perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

2. **Spindle:** Copper-coated low carbon steel, fully annealed, 0.105 inches in diameter, length to suit depth of insulation indicated.

3. **Insulation-Retaining Washers:** Self-locking washers formed from 0.016 inch thick galvanized steel sheet, with beveled edge for increased stiffness, sized as required to hold insulation securely in place, but not less than 1-1/2 inches square or in diameter.
   a. Where spindles will be exposed to human contact after installation, protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap.

4. **Anchor Adhesive:** Product with demonstrated capability to bond insulation anchors securely to substrates.

5. **Products:** Subject to compliance with requirements, provide one of the following:
   a. Adhesively attached, spindle type anchors
      1. TACTOO Insul-Hangers; AGM Industries, Inc. Canton, MA
      2. Spindle Type Gemco Hangers; Gemco, Danville, IL
   b. Insulation - Retaining Washers
      1. RC150; AGM Industries Inc, Canton, MA
      2. R150; Gemco, Danville, IL
   c. Adhesive
      1. TACTOO Adhesive; AGM Industries, Inc. Canton, MA
      2. Tuff Bond Hanger Adhesive; Gemco, Danville, IL

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**PART 3 - EXECUTION**
3.01 INSPECTION:

A. The Installer must examine the substrate and conditions under which the insulation work is to be performed, and notify the General Contractor in writing of unsatisfactory conditions. Do not proceed with the insulation work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 INSULATION:

A. General:

1. Comply with manufacturer's instructions for the particular conditions of installation in each case. If printed instructions are not available or do not apply to the project conditions, consult the manufacturer's technical representative for specific recommendations before proceeding with the work.

2. Extend insulation full thickness as shown over entire area to be insulated. Cut and fit tightly around obstructions, and fill voids with insulation. Remove projections which interfere with placement.

3. Apply a single layer of insulation of the required thickness unless otherwise shown or required to make up the total thickness.

B. Perimeter Insulation:

1. On vertical surfaces, set units in adhesives applied in accordance with manufacturer's instructions. Use type adhesive recommended by manufacturer of insulation.

C. General Building Insulation:

1. Apply insulation units to the substrate by the method indicated, complying with the manufacturer's recommendations. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage, to provide permanent placement and support of units.

2. Set vapor barrier faced units with vapor barrier to
warm side of construction, except as otherwise shown. Do not obstruct ventilation spaces, except for firestopping.

a. Tape joints and ruptures in vapor barriers, using adhesive tape of type recommended by insulation manufacturer, and seal each continuous area of insulation to surrounding construction so as to ensure vapor-tight installation of the units.

3. Stuff loose mineral fiber insulation into miscellaneous voids and cavity spaces as indicated. Compact to approximately 40% of normal maximum volume (to a density of approximately 2.5 lbs. per cu. ft.).

END OF SECTION 07200
SECTION 07500 - MEMBRANE ROOFING

The General Conditions, Supplementary General Conditions and General Requirements (Division 1) are a part of all Divisions and all other documents bound herein.

PART 1 - GENERAL

1.01 WORK INCLUDED


B. Roof deck insulation including tapered insulation and tapered insulation saddles for membrane roofing

C. Specified Flashing & Accessories

D. Installation of Walkway Pads

1.02 RELATED WORK

A. Section 06100 - Carpentry

B. Section 07600 – Flashing and Sheet Metal - Gravel stops and counter flashings for single-ply membrane roofing systems

1.03 QUALITY ASSURANCE

A. Membrane roofing and associated work for a single building shall be subcontracted to a single firm, hereinafter called the "Roofing Contractor", so there will be undivided responsibility for the work.

1. The Roofing Contractor shall be franchised or otherwise accepted in writing by the roofing materials manufacturer for installation of fully-guaranteed roof in accordance with the requirements.

a. Roofing materials manufacturer for membrane roofing system shall be one publishing complete information on the required system and offering to guarantee or bond the completed roofing installation as required.

b. Secondary materials shall be obtained from sources acceptable to the manufacturer of the primary membrane roofing system materials.
2. Refer to Section 01400, "Quality Control" for information on Owner's option to obtain services of an Authorized Material Manufacturer's Field Representative to assist in quality assurance services.

B. Membrane roofing system and associated work shall satisfy "Class A" rating as tested, listed and labeled by Underwriters Laboratories and conform to UL classified wind uplift resistance - UL1897 FM requirements FM 4470 Class 1, 1-90 windstorm.

1.04 SUBMITTALS

A. If the Roofing Contractor wishes to use a manufacturer's detail differing from these Specifications, the Roofing Contractor shall submit a written request prior to construction for authorization by the Owner's Representative; no changes will be permitted without such written authorization.

B. The Roofing Contractor shall submit two (2) copies of the most current edition of specifications and installation instructions from the manufacturer for each major roofing product or system required.

1. The Roofing Contractor shall indicate by transmittal form that their installers have received a copy of the manufacturer's installation instructions and recommendations. Data substantiating compliance with such requirements shall also be provided.

2. Such manufacturer's specifications and installation instructions shall become a part of these Specifications.

C. Should the Owner require information on reference projects of the Roofing Contractor, such projects shall be located within fifty miles of the Owner's office. Each project must be at least three years old and must be available for inspection by the Owner's Representative.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Materials shall be delivered in their original, unopened containers, clearly labeled with the manufacturer's name, brand name, and such identifying numbers as are appropriate.
B. Materials shall be stored neatly in areas acceptable to the Owner's Representative and dispersed so as to minimize fire hazard.

C. Loads placed on the roof at any point shall not exceed the safe loading for which the roof is designed.

1.06 JOB CONDITIONS

A. All substrates to be treated shall be smooth, visually dry, and free of dirt, debris and foreign matter before any treatment is initiated.

1. Proceed with roofing work only after substrate construction and penetrating work have been completed.

2. Proceed with roofing work only when weather conditions will permit the work to proceed in accordance with the manufacturer's recommended limitations.

B. A Pre-roofing Conference will be held at the project site well in advance of the time scheduled for roofing work, to review requirements for the work and conditions which could possibly interfere with successful performance of the work. Attendance will be required for every party concerned with the work or designated to coordinate it or to protect it thereafter.

C. Equipment shall be located on the ground, at a safe distance from the buildings, in a location acceptable to the Owner's Representative.

D. Competent operators shall be in attendance at all times when equipment is in use. The Roofing Contractor shall be responsible for exercising all reasonable precautions to avoid fires, and shall provide suitable fire extinguishers, readily accessible.

E. Installation of the roofing system is not restricted because of cold temperatures. Follow precautions as stated for storage, and expose only enough cement and adhesive to be used within a four (4) hour period.
F. Exercise precautions in use of cements and bonding adhesives as follows:

1. Such materials contain petroleum distillates; avoid breathing vapors.
2. Such materials are extremely flammable; do not use near fire or flame.

G. Waste products (petroleum, grease, oil, and solvents - vegetable or mineral oil and animal fat) and direct contact with steam venting should not be allowed to come in contact with the roofing system.

1.07 GUARANTEE/WARRANTY

A. The single-ply roofing system manufacturer's Warranty shall consist of a standard limited warranty for a fifteen (15) year total system warranty of water-tight integrity of the system. Upon completion of the roofing installation, an inspection shall be made by a representative of the manufacturer to ascertain that the roofing system has been installed according to the manufacturer's specification and details. The Warranty shall be issued upon approval of the installation by the manufacturer.

PART TWO - PRODUCTS

2.01 STANDARD OF MANUFACTURE

A. To establish construction standards and functional and aesthetic requirements to be met in the work of this Section the Drawings and Specifications are based upon single ply membrane roofing systems noted here.

1. Manufacturer’s
   a. Carlisle
   b. GAF
   c. Johns Manville
   d. Sika-Sarnafil

2.02 THERMOPLASTIC MEMBRANE ROOFING

A. General:

1. Scope: The Roofing Contractor shall furnish and install a single-ply membrane roofing system that is fabricated from uniform, polyester-reinforced flexible sheet compounded from PVC resins and plasticizers, stabilizers, fillers and pigments, of
the following material, thickness, backing, exposed face, color and physical properties:

a. Sheet Material: Copolymer alloy
b. Sheet thickness: 60 mils, nominal
c. Backing: No backing
d. Exposed face color: white

B. Warranty

1. Provide manufacturer’s standard written 15 year limited warranty at no additional charge. Upon warranty inspection and acceptance of the roof, the warranty shall be turned over to the Owner by the Manufacturer’s Quality Assurance Technician.

C. Weight Requirements

1. The total weight of the installed roofing system including all accessories, i.e., screws, plates, etc., shall not exceeds 28 pounds per square.

D. Submittals

1. Written confirmation from the roofing manufacturer that the Roofing Contractor is an authorized Dealer/Contractor.
2. Shop drawing showing the layout of the prefabricated roofing panels.

E. Product Delivery, Storage & Handling Procedures

1. Follow the roofing manufacturer’s instructions, cautions, warnings and procedures.
2. Roofing system shall not be applied when weather conditions are not within the range acceptable under the roofing manufacturer’s recommendations.

2.03 PRODUCT

A. Roof Membrane Physical Properties: Provide compounded thermoplastic sheets with the following properties as determined per ASTM test method indicated:

2. Elongation at Break: 35 percent; ASTM D 751.
3. Tearing Strength: 130 x 110 lbf minimum; ASTM D 751, Procedure B.
4. Seam Strength: 75 percent, minimum, of breaking strength of unseamed sample; ASTM D 751, Procedure B.

5. Resistance to Heat Aging: 90 percent retention of breaking strength and elongation at break after 56 days at 176 deg F or after 28 days at 185 deg F; ASTM D 3045.


7. Accelerated Weathering Test: No cracking or crazing after 5000 hours; ASTM D 4434.

8. Linear Dimension Change: 0.1 percent maximum after 6 hours at 176 deg F; ASTM D 1204.

9. Water Absorption: Less than 3 percent mass change after 168 hours immersion at 158 deg F; ASTM D 570.

2.04 INSULATION

A. Bottom layers and tapered insulation:

1. ASTM C1289-98 FS HH-I-1972/2(1) Class 1, isocyanurate.

B. Bottom layer thickness: 4 x 8 x 2 x (2) layers tapered insulation: 4 x 8 x .5 minimum thickness.

PART THREE - EXECUTION

3.01 SUBSTRATE INSPECTION

A. Inspect all surfaces to receive roofing for any condition that will adversely affect execution, performance, or quality of work.

B. All roof surfaces and all slope surfaces to drains and outlets shall be checked and approved by the Roofing Contractor prior to the start of the roofing work.

C. Install roofing material only under satisfactory conditions as specified by membrane manufacturer.

D. General Requirements:

1. Precautions
   a. Do not lay out or expose any insulation on the deck that can not be covered by membrane on the same day.
b. In making all field heat welds, make sure all edges are clean and free of tar, mastic or other foreign items.
c. Do not expose membrane and accessories to a constant temperature in excess of 110 degrees Fahrenheit.
d. Sealants and adhesives should be applied according to roofing manufacturer’s specifications.
e. Start securing the membrane at the highest point and work towards the drains.

2. Protection of Roofing Surfaces
   a. Storing, wheeling or tucking directly on roof insulation or membrane surface is not recommended. Smooth, clean plywood or plank walkways, runways and platforms shall be provided as necessary.

E. Insulation Installation

1. The roof insulation shall be installed with approved fasteners and distribution plates placed according to the manufacturer’s most recent published specifications for the use under the roofing manufacturer’s system and for issuance of the warranty.

F. Membrane Installation

1. Install the roofing system to the roofing manufacturer’s most recent published specifications.
2. Flash all penetrations (pipes, conduits, etc.) in the membrane. Factory prefabricated pipe seals shall be used to flash all pipes where installation is possible. Where factory prefabricated pipe seals cannot be installed, field fabricated pipe seals may be used if approved. All flashings and termination shall be done in accordance with approved manufacturer's details.

END OF SECTION 07500
SECTION 07600 - FLASHING AND SHEET METAL

PART ONE - GENERAL

1.01 WORK INCLUDED

A. Counterflashings for membrane roofing system
B. Copings for membrane system

1.02 RELATED WORK

A. Section 06100 - Carpentry
B. Section 07500 – Membrane Roofing

1.03 QUALITY ASSURANCE

A. Requirements of current edition of "Architectural Sheet Metal Manual" published by Sheet Metal and Air Conditioning Contractors' National Association, Inc. ("SMACNA") shall form a part of these Specifications except as otherwise specified or shown on Drawings.

1.04 SUBMITTALS

A. The Contractor shall submit a list of materials and description of installation methods proposed for this work for review by the General Contractor and Architect.

B. Shop drawings and color samples will be required for gravel stops in accordance with Spec Section 01330 Submittals. Fabrication of the work shall not commence until shop drawings bearing Subcontractor's final corrections have been reviewed and returned by the Owner's Representative.

1.05 WARRANTY/GUARANTEE

A. The Contractor shall furnish a written Guarantee warranting all sheet metal including metal flashing to remain serviceable and in good condition for two (2) years from date of final acceptance of the building and to promptly repair and place in good condition without additional expense to the Owner any sheet metal and metal flashings which become defective within that period.
B. Manufacturer’s Standard Warranty: Warranted materials shall be free of defects in material and workmanship for five years after shipment. If, after inspection, the manufacturer agrees that materials are defective, the manufacturer shall, at their option, repair or replace them. For decorative finish warranty, consult manufacturer.

C. Special Performance/20-Year Warranty: In addition to standard warranty listed above, manufacturer shall guarantee that a standard size roof edge system, when installed per manufacturer’s instructions, will not blow off or cause membrane failure, even in wind conditions up to 110 mph, or the manufacturer shall replace or repair their materials.

PART TWO - PRODUCTS

2.01 MATERIALS

A. Parapet coping for single ply membrane roofing system shall be “Perma Tite Coping” as manufactured by Metal Era, Inc., Waukesha, WI. Coping shall be .050 aluminum (with welded miters) with Kynar 500 coating. Finish shall be spray applied Kynar 500 in color selected by Owners’ representative from manufacturers standard color range. Support and cleat shall be 20 gauge pre-punched galvanized cleat with stainless steel spring mechanically locked to cleat normally 12” wide at 4’-0” o.c. mechanically fastened as indicated and detailed fasteners shall provide a minimum pull out resistance of 240# per substrate application. No exposed fasteners shall be permitted. Fasteners shall be electrolytically compatible. A concealed joint cover shall be installed on the face.

1. Alternate Manufacturer: Permasnap with coping meeting above criteria by WP Hickman with 20 year excel warranty.

B. Exposed and concealed metal flashings, including metal counterflashings at parapets and metal drip edge for concealed fabric flashing shall be of soft stainless steel cold rolled sheet or strip of Type 302/304 alloy having a 2-D dull fully annealed finish, which shall have at least its exposed portions painted after fabrication in a color to match adjoining metal work.
1. Counterflashing at parapets shall be two-piece type, with flashing of at least 20 gauge stainless steel having a receiver of at least 20 gauge stainless steel.

2. Metal drip flashing shall be placed over concealed flashing at lintels and all other metal flashings shall be of at least 18 gauge stainless steel.

PART THREE - EXECUTION

3.01 INSTALLATION

A. Metal coping system shall be installed in accord with manufacturer's published instructions.

B. Provide counterflashing for all base flashings of the single ply membrane roofing system. Turn metal down at least four inches over upper portion of such base flashings. Provide flashings at roof curbs and where else required to make roofing and sheet metal watertight.

C. Provide and install drip flashings for fabric concealed flashing over steel lintels at heads of openings, doors, and windows, and where else shown in exterior walls.

D. Insulate sheet metal from other materials using roofing felt, roofer's mastic, bituminous paint or other materials acceptable to Owner's Representative.

END OF SECTION 07600
PART ONE - GENERAL

1.01 SECTION INCLUDES:

A. Preformed, prefinished metal roofing and flashings.
B. Miscellaneous trim, flashing, closures, drip flashing, and accessories.
C. Sealant
D. Fastening devices.

1.02 RELATED SECTIONS

A. Section 05120: Structural Steel
B. Section 05500: Metal Fabrications.
C. Section 06100: Carpentry.
D. Section 07600: Flashing and Sheet Metal.
E. Section 07920: Sealants.

1.03 REFERENCES

A. American Iron & Steel Institute (AISI) Specification for the Design of Cold formed Steel Structural Members.
B. ASTM A-525 Steel Sheet, Zinc-Coated (Galvanized)
C. ASTM E-1680
D. ASTM E-1646
E. ASTM E-1592
F. Spec Data Sheet - Aluminum Zinc Alloy Coated Steel (Galvalume) Sheet Metal by Bethlehem Corp.

1.04 ASSEMBLY DESCRIPTION

A. The roofing assembly includes preformed sheet metal panels, related accessories, valleys, hips, ridges, eaves, corners, rakes, miscellaneous flashing and attaching devices.

1.05 SUBMITTALS

A. Submit detailed drawings showing layout of panels, anchoring details, joint details, trim, flashing, and accessories. Show details of weatherproofing, terminations, and penetrations of metal work.
B. Submit a sample of each type of roof panel, complete with factory finish.

C. Submit results indicating compliance with minimum requirements of the following performance tests:
   1. Air Infiltration      ASTM E 1680
   2. Water Infiltration    ASTM E 1646
   3. Wind Uplift - U.L.90

D. Submit calculations with registered engineer seal, verifying roof panel and attachment method resists wind pressures imposed on it pursuant to applicable building codes.

1.06 QUALITY ASSURANCE

A. Manufacturer: Company specializing in Architectural Sheet Metal Products with ten (10) years minimum experience.

1.07 DELIVERY, STORAGE AND HANDLING

A. Upon receipt of panels and other materials, installer shall examine the shipment for damage and completeness.

B. Panels should be stored in a clean, dry place. One end should be elevated to allow moisture to run off.

C. Panels with strippable film must not be stored in the open, exposed to the sun.

D. Stack all materials to prevent damage and to allow for adequate ventilation.

1.08 WARRANTY

A. Paint finish shall have a twenty year guarantee against cracking, peeling and fade (not to exceed 5 N.B.S. units).

B. Galvalume material shall have a twenty year guarantee against failure due to corrosion, rupture or perforation.

C. Applicator shall furnish guarantee covering watertightness of the roofing system for the period of two (2) years from the date of substantial completion.
D. Provide manufacturers standard watertight warranty on the roofing system for a period of 20 years from the date of substantial completion.

PART 2 PRODUCT

2.01 ACCEPTABLE MANUFACTURERS

A. Berridge Manufacturing Company, Houston, Texas.

B. Other manufacturers as approved by Architect.

2.02 SHEET MATERIALS

A. Prefinished Metal shall be Hot-Dipped Galvanized - ASTM A446-85 Grade C G90 Coating A525-86 24 Gauge core steel or prefinished galvalume-ASTM 792-86 AZ-55.

B. Unfinished Metal shall be Grade C Galvalume ASTM 792-86, AZ 55, "Satin Finish".

C. Finish shall be full strength Kynar 500 Fluoropolymer coating, applied by the manufacturer on a continuous coil coating line, with a top side dry film thickness of 0.70 to 0.90 mil over 0.25 to 0.35 mil prime coat, to provide a total dry film thickness of 0.95 to 1.25 mil. Bottom side shall be coated with primer with a dry film thickness of 0.25 mil. Finish shall conform to all tests for adhesion, flexibility, and longevity as specified by the Kynar 500 finish supplier.

D. Strippable film shall be applied to the top side of the painted coil to protect the finish during fabrication, shipping and field handling. This strippable film must be removed immediately before installation.

2.03 ACCESSORY MATERIALS

A. Fasteners: Stainless Steel with washers where required.

B. Sealant: Sealant must be a ultra low modulus, high performance, one-part, moisture curing silicone joint sealant. (do not use a clear sealant or sealants which release a solvent or acid during curing).
Sealant must be resistant to environmental conditions such as wind loading, wind driven rain, snow, sleet, acid rain, ozone, ultraviolet light and extreme temperature variations.

Features must include joint movement capabilities of +100% & -50% ASTM C-719, capable of taking expansion, compression, transverse and longitudinal movement, service temperature range -65°F to 300°F (-54°C to 149°C), Flow, sag or slump: ASTM C-639; Nil, Hardness (Shore A): ASTM C-661; 15, Tensile strength at maximum elongation: ASTM D-412; 200 psi, Tensile strength at 100% elongation: ASTM D-412; 35 psi, Tear strength, (die “C”); ASTM D-624; 40 pli, Peel strength (Aluminum, Glass, Concrete): ASTM C-794; 30 pli

C. Vinyl Weatherseal Insert.

2.04 FABRICATION

A. All exposed adjacent flashing shall be of the same material and finish as the roof panels.

B. Hem all exposed edges of flashing on underside, 1/2 inch.

2.05 PREFORMED METAL PANELS, STANDING SEAM METAL ROOF:

A. BERRIDGE TEE-PANEL - STANDING SEAM ROOF PANEL

1. Panels shall have 12-3/4" on center seam spacing with a seam height of 1".

2. Panels shall be site-formed with Portable Roll Former in continuous lengths with a 4’ min. radius to conform to solid sheathed curved substrates.

3. Snap-on seams shall be 1” in height and shall contain the Berridge factory-applied Extruded Vinyl Weather Seal Insert (Patent No. 4641475) to prevent siphoning of moisture through the standing seam.

4. Concealed anchor clips shall be spaced as required to meet uplift loads (provide 12” on center maximum).

5. Panel assembly shall bear Underwriters Laboratories Label UL90, pursuant to Construction Number 296 and applicable Fire Ratings.
6. Certification shall be submitted based on independent testing laboratory, indicating no measurable water penetration or air leakage beyond allowable tolerances through the system when tested in accordance with ASTM E-331-86 and E-283-84.

7. Color: To be determined from manufacturer’s standard colors.

B. SOFFIT: BERRIDGE VEE-PANEL (VENTED)

1. Panels shall have 10-7/8" exposure, 3/8" deep vee grooves at 3-5/8" on center, with concealed fasteners and interlocking sidelpap.
2. Panels shall be formed in continuous lengths per soffit length (40' max) and shall have no exposed fasteners.
3. Attachment to metal supports with #8 x 12" TEKS screws at maximum spacing of 2'-0" on center or per local code, whichever is greater.
4. Provide Vented Vee-Panel shall have a Net Free Vent Area (NFVA) of 9.07 square inches per lineal foot of panel (10.01 square inches for square foot of panel).
5. Color: To be selected from manufacturer’s full color choices.

PART 3 EXECUTION

3.01 INSPECTION

A. Substrate:

1. Examine plywood deck to ensure proper attachment to framing.
2. Inspect roof deck to verify deck is clean and smooth, free of depressions, waves or projections, level to ¼" in 20', and properly sloped to eaves.
3. Verify roof openings, curbs, pipes, sleeves, ducts or vents through roof are solidly set, cant strips and reglets in place, and nailing strips located.
4. Verify deck is dry and free of snow or ice. Joints in wood deck to be solidly supported and nailed.

B. Underlayment:

1. Provide ice & water shield membrane over entire substrate below metal roofing.
2. Ensure felt installed horizontally, starting at eave to ridge with a 6" minimum overlap and 18" endlaps.

3. Ensure that all nail heads are totally flush with the substrate. Nails shall be galvanized roofing nails with Berridge Coated Felt Caps.

3.02 INSTALLATION

A. Comply with manufacturers standard instructions and conform to standards set forth in the Architectural Sheet Metal Manual published by SMACNA, in order to achieve a watertight installation.

B. Install panels in such a manner that horizontal lines are true and level and vertical lines are plumb.

C. Install starter and edge trim before installing roof panels.

D. Remove protective strippable film prior to installation of roof panels.

E. Attach panels using manufacturer’s standard clips and fasteners, spaced in accordance with approved shop drawings.

F. Install sealants for preformed roofing panels as approved on shop drawings.

G. Do not allow panels or trim to come into contact with dissimilar materials.

H. Do not allow traffic on completed roof. If required, provide cushioned walk boards.

I. Protect installed roof panels and trim from damage caused by adjacent construction until completion of installation.

J. Remove and replace any panels or components which are damaged beyond successful repair.
3.03 CLEANING

A. Clean any grease, finger marks or stains from the panels per manufacturer’s recommendations.

B. Remove all scrap and construction debris from the site.

3.04 FINAL INSPECTION

A. Final inspection will be performed in accordance with Spec Section 01450 by an independent firm.

END OF SECTION 07610
PART I GENERAL

1.01 RELATED DOCUMENTS

A. The provisions included under Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements are included as part of this section as though bound herein.

1.02 SUMMARY

A. Provide labor, material, and equipment necessary for furnishing a complete installation of industrial series commercial gutter system.

B. Related Work Specified Elsewhere

1. Division 6 Sections for nailers and support framing.
2. Division 7 Sections for related roofing materials.

1.03 SUBMITTALS

A. Product Data: Each type of product specified. Submit manufacturer’s detailed technical product data, installation instructions and recommendations, dimensions of individual components, profiles, and finishes.

B. Shop Drawings: Show fabrication and installation of industrial series commercial gutter system including fully dimensioned roof plans, expansion joint locations, sections and details of components and other related trims.

C. Finish & Color Selection: Furnish manufacturer’s technical data for custom colors.

1.04 QUALITY ASSURANCE
A. Where pre-engineered manufactured products are specified, other field fabricated or shop/field fabricated substitutions will not be accepted. However, where shop/field fabrications are indicated pre-engineered systems will be considered with Architect approval.

B. Obtain all components and related accessories from one single source manufacturer.

C. Follow manufacturer’s printed instructions for installing commercial gutter system. Follow primary roofing manufacturer’s printed instructions for installing associated roof material for flashing gutter system to roof.

1.05 DELIVERY, STORAGE & HANDLING

A. All products delivered shall be stored in a clean dry location prior to installation.

B. Products furnished with strippable protective masking shall not be exposed to direct sunlight for more than 30 minutes without removing masking.

C. Do not install finished materials with scars or abrasions.

1.06 PRODUCT CONDITIONS

A. Coordinate work of this Section with adjoining work for proper sequencing to ensure protection from inclement weather and to protect materials and their finish against damage.

B. Do not install commercial gutter system during inclement weather. When installing in cold climates, warm adhesives, caulks, and primers to at least 50 degrees Fahrenheit prior to application.

1.07 DESIGN PERIMETERS
A. Commercial Gutter System shall conform to all local building codes and SMACNA design perimeters for architectural sheet metal.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Provide commercial gutter system, accessories, and drainware as manufactured by Perimeter Systems, a division of Southern Aluminum Finishing Company, Inc. 143 Charlotte, Suite 102, Sanford, North Carolina 27330, 1-800-334-9823.

2.02 TYPE


2.03 MATERIALS & FABRICATION

A. Gutter shall be manufactured from .063” Kynar color to match standing seam roofing system in 10’-0” lengths. Gutter shall be:
   1. Manufactured with 1” telescoping and notched end.
   2. Factory punched with fastening holes elongated to allow for thermal movement.
   3. Press formed on a CNC press to provide repeated true and accurate profiles.

B. Support Brackets shall be manufactured from 0.125”x1.00” factory extruded aluminum bar punched for fasteners.

C. Interior Straps shall be manufactured from 0.125”x 1.00” extruded aluminum (mill finish).

2.04 ACCESSORIES

A. Mitered Corners, provide factory-mitered corners.

B. Sculptured End Caps, provide factory end caps at all gutter ends and wall abutments.
C. Gutter Expansion Joint, provide manufacturer’s elastomeric expansion joints with exterior cover plates at 40’ intervals or as shown on drawings.

2.05 DRAINWARE

A. Downspout & Elbows, connect to existing. Where existing is damaged or infeasible, provide rectangular extruded downspout Model Number DS-EX in sizes and locations as indicated on plans. Downspouts shall be manufactured from 1/25 aluminum custom Kynar finished to match gutter fascia. Downspout elbows shall have heliarc welded joints.

B. Outlets, at all downspout locations provide aluminum outlets to connect liner to downspout.

C. Wall Brackets, provide Style 1 Wall brackets at 30” maximum spacing (minimum 2 brackets). Brackets shall be manufactured from 0.125”x1.00” extruded aluminum bar, finished to match downspout.

2.06 FINISHES

A. General: Apply coatings to exposed aluminum components after fabrication for maximum coating performance and to prevent crazing, abrasion, and damage to finish surfaces.

B. Pretreatment: Aluminum components shall be pretreated with solutions to remove organic and inorganic surface soils, remove residual oxides, followed by chrome phosphate conversion coating to which organic coatings will firmly adhere.

C. Coating Type: High Performance Coating, two-coat, shop applied, 70% Polyvinylidene Fluoride (PVDF) coating based on Elf Atochem, Inc. Kynar 500 or Ausimont U.S.A., Inc. Hylar 5000 resin, meeting AAMA 2605 specification.

D. Color: Custom color to match Standing Seam Roofing System.

PART 3 EXECUTION

3.01 EXAMINATION
A. The installer must examine substrates and conditions under which commercial gutter system will be installed. All wood plates and/or fascia boards shall be installed true, straight, and free of splits, cracks, or other irregularities. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Prior to the installation of the industrial series commercial gutter system, soffits, extenders, and associated trims shall be installed.

B. Installer shall thoroughly read and follow manufacturer’s installation instructions before proceeding with installation.

3.03 INSTALLATION

A. General: The industrial series commercial gutter system shall be installed in strict accordance with manufacturer’s printed instructions. Deviations from the instructions are not allowed.

B. Support Brackets: Layout support brackets to provide 1/8” slope in 40 linear feet. Install support brackets with #10 x 2” stainless steel wood screws.

C. Gutter: Install gutter onto support brackets and fasten to substrates with 1-1/2” aluminum or stainless steel nails. Rivet and seal gutter joints with high grade exterior sealant as recommended by gutter manufacturer.

D. Expansion Joints: Install elastomeric expansion joints as shown on plans and/or shop drawings. Maximum expansion joint spacing shall be 40’ centers.

E. Install interior straps by fully engaging them into liner and fascia, complete by securely riveting.
END OF SECTION 07711
PART I - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this section.

1.02 DESCRIPTION OF WORK:

A. Provide labor and materials necessary for complete installation of firestopping materials and systems. Section includes firestopping for the following:

1. Penetrations through fire resistance rated walls and roof construction including both empty openings and openings containing cables, pipes, ducts, conduits, and other penetrating items.

2. Penetrations through fire resistance rated walls and partitions including both empty openings and openings containing cables, pipes, ducts, conduits and other penetrating items.

3. Penetrations through smoke barriers and construction enclosing compartmentalized area involving both empty openings and openings containing penetrating items.

4. Sealant joints in fire resistance rated construction.

1.03 SUBMITTALS:

A. Product Data: Manufacturer's specifications and technical data for each material including the composition and limitations, documentation of UL or other nationally recognized independent testing laboratories firestop systems to be used and manufacturer's installation instructions.

1. Submit material safety data sheets (MSDS) provided with product delivered to jobsite.
B. Product certificates signed by manufacturers of firestopping products certifying that their products and installation comply with specified requirements. Certification shall be signed by the Installer.

1.04 QUALITY ASSURANCE:

A. Conform to applicable governing codes, including local governing authorities, but not limited to the following:

1. 2015 MBC

B. Meet requirements of ASTM E814 or UL 1479 tested assemblies that provide a fire rating equal to that of construction being penetrated and other ASTM Standards as applicable for the installation.

1. ASTM E84 "Test Method for Surface Burning Characteristics of Building Materials"

PARTS 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with through-penetration firestop systems (XHEZ) listed in Volume II of the UL Fire Resistance Directory, provide products by one of the following:

1. Hilti Construction Chemicals, Tulsa, OK
2. Specified Technologies Inc. (STI) Sommerville, NJ
3. 3M Fire Protection Products, St. Paul, MN
4. The Rectorseal Corp., Houston, TX
5. Tremco, Inc. Beachwood, OH

2.02 FIRESTOPPING, GENERAL

A. Compatibility: Provide firestopping composed of components that are compatible with each other, the substrates forming openings, and the items, if any, penetrating the firestopping under conditions of service and application, as demonstrated by firestopping manufacturer based on testing and field experience.
1. All materials shall comply with ASTM E814 or E119 (UL 1429), and shall be manufactured of non-toxic, non-hazardous, asbestos free materials and unaffected by water or moisture when cured.

2. Primers: Conform to manufacturer's recommendations for primers required for various substrate and conditions.

3. Backup materials: Backup materials, supports, and anchoring devices shall be provided as required by UL testing.

B. Accessories: Provide components for each firestopping system that are needed to install fill materials and to comply with "System Performance Requirements" in Part 1. Use only components specified by the firestopping manufacturer and approved by the qualified testing and inspecting agency for the designated fire resistance rated system. Accessories include but are not limited to the following items:

   1. Permanent forming/damming/backing materials must be noncombustible and may include the following:
      a. Semirefractory fiber (mineral wool) insulation.
      b. Sealants used in combination with other forming/damming materials to prevent leakage of fill materials in liquid state.
      c. Joint fillers for joint sealants.

   2. Temporary forming materials.
   5. Steel sleeves.

2.03 FIRE STOPPING, MATERIALS

A. Use only firestopping products that have been UL 1479 or ASTM E814 tested for specific fire rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements and fire rating involved for each separate instance.

B. For penetrations by noncombustible items including steel pipe, copper pipe, rigid steel conduit and electrical metallic tubing (EMT), the following materials are acceptable:
1. Hilti FAS 601 Elastomeric Firestop Sealant
2. STI SpecSeal Sealant SSS 100
3. 3M Fire Barrier CP25
5. Fyre-Sil, Tremco, Inc.
6. Biofireshield K10 and K2 Mortar, Biostop 500+, Biootherm 100/22200 & Biostop Putty, (The RectorSeal Corp.)

C. For penetrations by combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe (closed piping systems) the following materials are acceptable:

1. STI Wrap Strip SSW12
2. Hilti FS One Intumescent Firestop Sealant
3. 3M Fire Barrier FS-195 Wrap Strip
5. Biostop Wrap Strip, Collar, and Biostop 500+.

D. For large size/complex penetrations made to accommodate cable trays, multiple steel and copper pipes, electrical busways in raceways, the following materials are acceptable:

1. STI SpecSeal lightweight mortar SSM22B or putty
2. Hilti FS635 Trowelable Firestop Compound
3. 3M Fire Barrier FS-195 Composite Sheet
4. Biofireshield K-10 & K2 mortar
5. Metacaulk Firestop Mortar

E. For fire-rated construction joints and other gaps with movement, the following materials are acceptable:

1. Hilti FS 601 Elastomeric Firestop Sealant
2. STI Pensil 300
3. 3M (Dow Corning Fire Stop Sealant 2000)
4. Fyre-Sil, Tremco, Inc.
5. Biofireshield, Biostop 700, Biostop 500+
6. Metacaulk 1000 & 1100

F. Provide a firestopping system with an "F" rating as determined by UL 1479 or ASTM E814 which is equal to the time rating of construction being penetrated.
3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of firestopping. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning: Clean out openings and joints immediately prior to installing firestopping to comply with recommendations of firestopping manufacturer and the following requirements:

1. Remove all foreign materials from surfaces of opening and joint substrates and from penetrating items that could interfere with adhesion of firestopping.

2. Clean opening and joint substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with firestopping. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form release agent from concrete.

3.03 INSTALLING THROUGH-PENETRATION FIRESTOPS

A. General: Comply with the manufacturer's installation instructions and drawings pertaining to products and applications indicated.

B. Install forming/damming materials and other accessories of types required to support fill materials during their application and in the position needed to produce the cross sectional shapes and depths required to achieve fire ratings of designate through-penetration firestop systems. After installing fill materials, remove combustible forming materials and other accessories not indicated as permanent components of firestop systems.
C. Install fill materials for through-penetration firestop systems by proven techniques to produce the following results:

1. Completely fill voids and cavities formed by openings, forming materials, accessories and penetrating items.
2. Apply materials so they contact and adhere to substrate formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.04 INSTALLING FIRE RESISTIVE JOINT SEALANTS

A. General: Comply with the manufacturer's installation instructions and drawings pertaining to products and application indicated.

3.05 CLEANING

A. Clean off excess fill materials and sealant adjacent to openings and joints as work progresses by methods and with cleaning materials approved by manufacturers of firestopping products and of products in which opening and joints occur.

END OF SECTION 07840
SECTION 07910 - JOINT FILLERS AND GASKETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. The extent of each type of joint filler and gasket work is indicated on the drawings and by provisions of this section, and is hereby defined to include required fillers and gaskets not specified in other sections of these specifications.

B. The required applications of joint fillers and gaskets include, but are not necessarily limited to, the following general types and locations:

1. Isolation and expansion joint fillers in structural concrete.

2. Floor construction/expansion joint fillers.

3. Joint fillers around penetrations of equipment and services through walls, floors and roofs.

1.03 SUBMITTALS:

A. Product Data:

1. Submit manufacturer's specifications, installation instructions and recommendations for each type of material required.

B. Samples:

1. Submit three, 12 inches long samples of each joint filler or gasket.
PART 2 – PRODUCTS

2.01 MATERIALS, GENERAL:

A. Size and Shape: Provide sizes and shapes of units as shown or, if not shown, as recommended by manufacturer for joint size and condition shown. Where joint movement is a factor in a determination of size, consult with Architect to determine nature and magnitude of anticipated joint movements for the temperature and condition of project at time of installation.

B. Compressibility: Specified hardness and compressibilities are intended to establish requirements for normal or average conditions of installation and use. Where a range of hardness or compressibility is available for a product, comply with manufacturer's recommendations for specific condition of use.

C. Color: Provide each concealed material in manufacturer's standard color which has best overall performance characteristics for application shown. Provide exposed materials in black, except where another color is indicated.

D. Compatibility: Before purchase of each filler or gasket material, confirm that it is compatible with substrate, sealants and other materials in joint system.

E. Adhesives: Pressure sensitive adhesives, compatible with each material in joint system may be applied (at installer's option) to one face of joint fillers and gaskets to facilitate installation and permanent anchorage. Do not allow adhesives to contaminate sealant bond surface (if any) in joint system.

2.02 CONCRETE CONTROL/EXPANSION JOINT FILLERS:

A. Bituminous and Fiber Joint Filler:

1. Provide resilient and non-extruding type premolded bituminous impregnated fiberboard units complying with ASTM D 1751, FS HH-F-341, Type 1 and AASHO M 213.
2. Provide one of the following products:
   a. Flexcell-Knight-Celotex Corporation
   b. Expansion-Joint Filler; BASF/Sonneborn
   c. FF-14. Asphalt Fiber-Board; Progress Unlimited
   d. Fibre Expansion Joint; W.R. Meadows, Inc.
   e. Conflex Fiber Expansion Control Joint Filler, JD Russell

2.03 CELLULAR/FOAM EXPANSION JOINT FILLERS:

A. Closed-Cell PVC Joint Filler:

1. Provide flexible expanded polyvinyl chloride complying with ASTM D 1667. Grade VE 41 BL (3.0 psi compression deflection); except provide higher compression deflection grades as may be necessary to withstand installation forces.

2. Provide one of the following products:
   a. FF2 PVC: Progress Unlimited, Inc.
   b. Vinyl "U" 1000 Series: Williams Products, Inc.

2.04 GASKETS:

A. Molded Neoprene Gasket:

1. Provide extruded neoprene or EPDM gaskets complying with ASTM D 2000, Designation 2BC 415 to 3BC 620, black (40 to 60 Shore A durameter hardness); of the profile shown or, if not shown, as required by the joint shape, size and movement characteristics to maintain a watertight and airtight seal.

2. Provide products by one of the following manufacturers:
   a. D.S. Brown Company
   b. Hohmann & Barnard, Inc.
   c. Kirkhill Rubber Company
   d. Progress Unlimited, Inc.
   e. JD Russell
   f. Williams Products, Inc.
2.05 MISCELLANEOUS MATERIALS:

A. Oakum Joint Filler:

1. Provide untreated hemp or jute fiber rope, free of oil, tar and other compounds which might stain surfaces, contaminate joint walls or not be compatible with sealants.

B. Fire-Resistant Joint Filler:

1. Glass fiber or other inorganic non-combustible fiber formed with minimum of binder into resilient joint filler strips or blankets of sizes and shapes indicated, recommended by manufacturer specifically for increasing fire resistance or endurance of joint systems of type indicated, for service temperatures up to 2300 degrees F, 80% (min.) recovery 50% compression.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Installer must examine joint surfaces of units to receive fillers or gaskets and conditions under which the work is to be performed and notify the General Contractor, in writing, of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 INSTALLATION:

A. Comply with manufacturer's instructions and recommendations for installation of each type of joint filler or gasket required, unless more stringent requirements are shown or specified.

B. Set units at proper depth of position in joint to coordinate with other work, including installation of bond breakers, backer rods, and sealants. Do not leave voids or gaps between ends of joint filler units.

C. Recess exposed edges or faces of gaskets and exposed joint filler slightly behind adjoining surfaces, unless otherwise shown, so that compressed units will not protrude from joints.
D. Bond ends of gaskets together with adhesive or by means as recommended by manufacturer to ensure continuous watertight and airtight performance. Miter-cut and bond ends at corners except where molded corner units are provided.

END OF SECTION 07910
SECTION 07920 - SEALANTS AND CAULKING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:
   A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:
   A. The extent of each type of sealant and caulking work is indicated on the drawings, and by provisions of this section.
   B. The required applications of sealants and caulking include, but are not necessarily limited to, the following general locations:
      1. Flashing reglets and retainers.
      2. Exterior wall joints.
      3. Masonry control joints, exterior and interior.
      4. Interior sound-sealed and air-sealed joints.
      5. Flooring joints.
      6. Isolation joints, between structure and other elements.
      7. Paving and sidewalk joints.
      8. Joints at penetrations of walls, decks and floors by piping and other services and equipment.
      9. Joints between items of equipment and other construction.

1.03 QUALITY ASSURANCE:
   A. Manufacturers: Firms with not less than 5 years of successful experience in production of types of sealants and caulking compounds required for this project.
      1. Obtain elastomeric sealants from a manufacturer which will, upon request, send a qualified technical representative to the project site for purpose of advising installer on proper procedures for use of products.
B. Installer: A firm with a minimum of 5 years of successful experience in application of types of materials required.

1.04 SUBMITTALS:

A. Product Data:

1. Submit manufacturer's specifications, recommendations and installation and instructions for each type of sealant, caulking compound and associated miscellaneous material required.

B. Samples:

1. Submit three, 12" long samples of each color required (except black) for each type of sealant and caulking compound exposed to view. Install sample between two strips of material similar to or representative of typical surfaces where compound will be used, held apart to represent typical joint widths.

1.05 JOB CONDITIONS:

A. Pre-Installation Meeting: At the General Contractor's direction, installer, sealant manufacturer's technical representative, and other trades involved in coordination with sealant work shall meet with General Contractor at project site to review procedures and time schedule proposed for installation of sealants in coordination with other work. Review each major sealant application required on project.

B. Weather Conditions: Do not proceed with installation of sealants under adverse weather conditions, or when temperatures are below or above manufacturer's recommended temperature range for installation. Proceed with the work only when forecasted weather conditions are favorable for proper cure and development of high early bond strength. Where joint width is affected by ambient temperature variations, install elastomeric sealants only when temperatures are in lower third of the manufacturer's recommended installation temperature range, so that sealant will not be subjected to excessive elongation and bond stress at subsequent low temperatures. Coordinate time schedule with the General Contractor to avoid delay of project.
C. Statement of Non-Compliance: Where it is necessary to proceed with installation of sealants or caulking compound under conditions which do not fully comply with requirements (because of time schedule or other reasons which the General Contractor determines to be crucial to project), prepare written statement for Owner's record (with copy to Architect) indicating the nature of non-compliance, reasons for proceeding, precautionary measures taken to ensure best possible work, and names of individuals concurring with decision to proceed with installation.

1.06 SPECIAL PROJECT WARRANTY (GUARANTEE):

A. Sealant Warranty: Provide written warranty, signed by contractor and installer, agreeing to, within warranty period of 10 years after date of substantial completion, replace/repair defective materials and workmanship defined to include: Instances of significant leakage of water or air; failures in joint adhesion, material cohesion, abrasion resistance, strain resistance or general durability; failure to perform as required, and the general appearance of deterioration in any other manner not clearly specified in manufacturer's published product literature as an inherent characteristic of the sealant material. Warranty includes responsibility for removal and replacement of other work (if any) which conceals or obstructs the replacement of sealants.

PART 2 - PRODUCTS

2.01 MATERIALS, GENERAL:

A. Colors: Provide black or other natural color where no other standard or custom color is available. Where material is not exposed to view, provide manufacturer's standard color which has best overall performance characteristics for application shown.
1. Provide manufacturer's standard colors as selected by Architect from manufacturer's standard colors.

B. Hardnesses shown and specified are intended to indicate general range necessary for overall performance. Consult manufacturer's technical representative to determine actual hardness recommended for conditions of installation and use. Upon request, Architect will furnish information concerning anticipated joint movement related to actual joint width and installation temperature. Except as otherwise indicated or
recommended, provide compounds within the following range of hardness (Shore A, fully cured, at 75 degrees F.).

1. 5 to 20 for high percentage of movement and minimum exposure to weather and abrasion (including no exposure to vandalism).

2. 15 to 35 for moderate percentage of movement and moderate exposure to weather and abrasion.

3. 30 to 60 for low percentage of movement and maximum exposure to weather and abrasion (including foot traffic on horizontal joints).

C. Modulus of Elasticity: For joints subjected to movement, either thermal expansion of dynamic movement, select sealants from among available variations which have lowest modulus of elasticity which is consistent with exposure to abrasion or vandalism. For horizontal joints subject to traffic, select sealants with high modulus of elasticity as required to withstand indentation by stiletto heels. Comply with manufacturer's recommendations where no other requirements are indicated.

D. Compatibility: Before selection and purchase of each specified sealant, investigate its compatibility with joint surfaces, joint fillers and other materials in joint system. Provide only materials (manufacturer's recommended variation of specified materials) which are known to be fully compatible with actual installation conditions as shown by manufacturer's published data or certification.

2.02 SEALANTS:

A. One Part Elastomeric Sealant (Silicone)

1. One component elastomeric sealant, complying with ASTM C 920, Class 25, Type NS (nonsag), unless Type S (self-leveling) recommended by manufacturer for the application shown.

   a. Acceptable Standard
      1. "Pecora 864 Architectural Silicone Sealant; Pecora Corp.
      2. Dow Corning 791; Dow Corning Corp.
      3. Silpruf; General Electric
      4. Omniseal; Sonneborn Building Products, Inc.
      5. Spectrem 2; Tremco Mfg. Co.
2. One-Component mildew resistant silicone sealant: (Around countertops and backsplashes and other wet interior locations).
   a. Acceptable Standard
      1. Rhodorsil 6B white; Rhone-Poulenc Inc.
      2. Dow Corning 786; Dow Corning Corp.
      3. Sanitary 1700; General Electric

3. One Component high movement joints (+100/-50): Where locations of high movement are indicated.
   a. Dow Corning 790; Dow Corning Corp.
   b. Spectrem 1; Tremco

B. Elastomeric Sealant (Polyurethane)
   1. One component polyurethane sealant, complying with ASTM C 920, Type S, Grade NS, Class 25 (nonsag).
      a. Acceptable Standard
         1. Sonolastic NP 1; Sonneborn Building Products Inc.
         2. Dymonic; Tremco Mfg. Co.
         3. Dynatrol I; Pecora Corp.
         4. Vulkem 921; Mameco
         5. CS 2130; Hilti
         6. Sikaflex 1A; Sika Corp.
         7. Sikaflex 15LM; Sika Corp.

   2. Two Component polyurethane sealant, complying with ASTM C 920, Type M, Grade NS, Class 25 (nonsag).
      a. Acceptable Standard
         1. Sonolastic NP 2; Sonneborn Building Products Inc.
         2. Dymeric; Tremco Mfg. Co.
         3. Dynatrol II; Pecora Corp.
         4. Vulkem 922; Mameco
         5. Sikaflex 2cNSEZ; Sika Corp.

C. One-part self-leveling polyurethane sealant (for traffic areas).
   1. One Component polyurethane self-leveling sealant, complying with ASTM C 920, Type S, Grade P, Class 25.
      a. Acceptable Standard
         1. Sonolastic SL 1; Sonneborn Building Products Inc.
         2. NR-201 Urexpan; Pecora Corp.
         3. Vulkem 45; Mameco
         4. Sikaflex 1cSL; Sika Corp.
   a. Acceptable Standard
      1. Sonolastic SL 2; Sonneborn Building Products Inc.
      2. NR-200 Urexpans; Pecora Corp.
      3. Vulkem 245; Mameco
      4. THC900/THC901; Tremco
      5. Sikaflex 2cSL; Sika Corp.

D. Security Sealant (Polyurethane)
   1. One component or two component polyurethane sealant, complying with ASTM C 920, Grade NS, Class 12.5, with a Shore A Hardness of 55.
      a. Acceptable Standard
         1. Dynaflex; Pecora Corp.
         2. Ultra; Sonneborn Building Products, Inc.

2.04 CAULKING COMPOUNDS:

A. Caulking Compounds: (Acrylic Latex Sealant)
   1. Latex rubber modified, acrylic emulsion polymer sealant compound; manufacturer's standard, one part, nonsag, mildew resistant, acrylic emulsion sealant complying with ASTM C 834, formulated to be paintable and recommended for exposed applications on interior locations involving joint movement of not more than plus or minus 5 percent.
      2. Acceptable Standard
         a. Sonolac, Sonneborn Building Products Inc.
         b. Acrylic Latex Caulk 834, Tremco Inc.
         c. Acrylic Latex Caulk with Silicone, DAP
         d. AC-20, Pecora Corp.

2.05 MISCELLANEOUS MATERIALS:

A. Joint Cleaner: Provide type of joint cleaning compound recommended by sealant or caulking compound manufacturer, for joint surfaces to be cleaned.

B. Joint Primer/Sealer: Provide type of joint primer/sealer recommended by sealant manufacturer, for joint surfaces to be primed or sealed.
C. Bond Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer, to be applied to sealant-contact surfaces where bond to substrate or joint filler must be avoided for proper performance of sealant. Provide self-adhesive tape where applicable.

D. Sealant Backer Rod: Compressible rod stock polyethylene foam, polyethylene jacketed polyurethane foam butyl rubber foam, neoprene foam or other flexible, permanent, durable non-absorptive material as recommended for compatibility with sealant by the sealant manufacturer.

E. Provide size and shape of rod which will control joint depth for sealant placement, break bond of sealant at bottom of joint, form optimum shape of sealant bead on back side, and provide a highly compressible backer to minimize possibility of sealant extrusion when joint is compressed.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. The installer must examine joint surfaces, backing and anchorage of units forming sealant rabbet and condition under which sealant work is to be performed and notify the General Contractor in writing of conditions detrimental to proper completion of the work and performance by sealants. Do not proceed with sealant work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.02 SELECTION OF MATERIAL

A. Caulking compounds shall be used for interior nonmoving joints and at locations indicated.

B. One component elastomeric silicone sealants shall be used at exterior and interior joints where thermal or dynamic movement is anticipated including, but not limited to, the following locations:

1. Metal to metal joints.
2. Sheet metal flashing, coping, preformed metal caps, fascias, extenders, trim, and panels.
C. One or two component elastomeric polyurethane sealants shall be used at exterior and interior joints where weatherproofing or waterproofing is required and at exterior joints between dissimilar materials including, but not limited to, the following locations:

1. Expansion and control joints.
2. Exterior side of hollow metal frames to adjacent materials.
3. Exterior side of aluminum frames to adjacent dissimilar materials.
4. Lintels and shelf angles to masonry construction.
5. Louvers to adjacent construction.
6. Vertical interior and exterior expansion joints and horizontal interior and exterior control joints and expansion joints in the building.
7. Joints in concrete site improvements (sidewalks, ramps, retaining walls) and the joint between the concrete slabs and dissimilar materials.
8. Sealant in pipe sleeves where materials must perforate the floor slab.
9. Perimeter of floor slabs or concrete curbs which abut vertical surfaces.
10. Exterior joints between dissimilar materials where the joining of the two surfaces leaves a gap between the meeting materials or components as may be dictated by the various methods of construction to make watertight.
11. Exterior locations which are noted "caulked" or "sealant" and not specifically listed herein or included in the work of other sections of the Specifications.
12. Interior joints between dissimilar materials where the joining of the 2 surfaces leave a gap between the meeting materials and components.

D. One or two part self-leveling polyurethane sealants shall be used for exterior and interior horizontal joints subject primarily to pedestrian traffic and light and moderate vehicular traffic.

E. Security sealant shall be used in vertical control joints in the interior side of building.

3.03 JOINT SURFACE PREPARATION:

A. Clean joint surfaces immediately before installation of sealant or caulking compound. Remove dirt, insecure coatings, moisture and other substances which would interfere with bond of sealant or caulking compound.
B. For elastomeric sealants, do not proceed with installation of sealant over joint surfaces which have been painted, lacquered, waterproofed or treated with water repellent or other treatment or coating unless a laboratory test for durability (adhesion), in compliance with paragraph 4.3.9. of FS TT-S-00227 has successfully demonstrated that sealant bond is not impaired by coating or treatment. If laboratory test has not been performed or shows bond interference, remove coating or treatment from joint surfaces before installing sealant.

C. Etch concrete and masonry joint surfaces to remove excess alkalinity, unless sealant manufacturer's printed instructions indicate that alkalinity does not interfere with sealant bond and performance. Etch with 5% solution of muriatic acid; neutralize with dilute ammonia solution, rinse thoroughly with water and allow to dry before sealant installation.

D. Roughen joint surfaces on vitreous coated and similar non-porous materials, where sealant manufacturer's data indicated lower bond strength than for porous surfaces. Rub with fine abrasive to produce a dull sheen.

3.04 INSTALLATION:

A. Comply with sealant manufacturer's printed instructions except where more stringent requirements are shown or specified and except where manufacturer's technical representative directs otherwise.

B. Prime or seal joint surfaces where shown or recommended by sealant manufacturer. Do not allow primer/sealer to spill or migrate onto adjoining surfaces.

C. Install sealant backer rod for liquid sealants, except where shown to be omitted or recommended to be omitted by sealant manufacturer for the application shown.

D. Install bond breaker tape where shown and where required by manufacturer's recommendations to ensure that elastomeric sealants will perform properly.

E. Employ only proven installation techniques, which will ensure that sealants will be deposited in uniform, continuous ribbons without gaps or air pockets, with complete "wetting" of joint bond surfaces equally on opposite sides. Except as otherwise indicated, fill sealant rabbet to a slightly concave surface, slightly
below adjoining surfaces. Where horizontal joints are between a horizontal surface and a vertical surface, fill joint to form a slight cove, so that joint will not trap moisture and dirt.

F. Install sealants to depths as shown or if not shown as recommended by sealant manufacturer but within the following general limitations, measured at center (thin) section of bead.

1. For sidewalks, pavement and similar joints sealed with elastomeric sealants and subject to traffic and other abrasion and indentation exposures, fill joints to a depth equal to 75% of joint width and neither more than 5/8" deep nor less than 3/8" deep.

2. For normal moving joints sealed with elastomeric sealants, but not subject to traffic, fill joints to a depth equal to 50% of joint width, but neither more than 1/2" deep nor less than 1/4" deep.

3. For joints sealed with non-elastomeric sealants and caulking compounds, fill joints to a depth in the range of 75% to 125% of joint width.

G. Spillage: Do not allow sealants or compounds to overflow or spill onto adjoining surfaces or to migrate into voids of adjoining surfaces including exposed aggregate panels and similar rough textures. Use masking tape or other precautionary devices to prevent staining of adjoining surfaces but either primer/sealer or the sealant/caulking compound.

H. Remove excess and spillage of compounds promptly as the work progresses. Clean adjoining surfaces by whatever means may be necessary to eliminate evidence of spillage without damage to adjoining surfaces or finishes.

3.04 CURE AND PROTECTION:

A. Cure sealants and caulking compounds in compliance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength and surface durability. Do not cure in a manner which would significantly alter materials modulus of elasticity or other characteristics.
B. Installer shall advise the General Contractor of procedures required for curing and protection of sealants and caulking compounds during construction period, so that they will be without deterioration or damage (other than normal wear and weathering) at time of Owner's acceptance.

END OF SECTION 07920
PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. The extent of hollow metal work is shown on the drawings and schedules.

B. This section includes hollow metal doors and pressed steel frames for doors and related openings.

1.03 QUALITY ASSURANCE:

A. Provide doors and frames complying with ANSI A258.8-1998 (SDI-100) "Recommended Specifications for Standard Steel Doors and Frames" and as herein specified.

B. Fire-rated door assemblies shall be Underwriter Laboratory. Where fire-rated door assemblies are indicated or required, provide fire-rated door and frame assemblies that comply with NFPA 80 "Standard for Fire Doors and Windows", and have been tested, listed, and labeled in accordance with ASTM E 152 "Standard Methods of Fire Tests for Door Assemblies". All metal labels to be riveted to door and frames mylar labels not acceptable.

1.04 SUBMITTALS:

A. Product Data: Submit manufacturer's specifications for fabrication and installation, including data substantiating that products comply with requirements.

B. Shop Drawings: Submit shop drawings for the fabrication and installation of hollow metal work. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of finish hardware and reinforcements, and details of joints and connections.

1. Provide a schedule of doors and frames using same reference numbers for details and openings as those on the contract drawings.
1.05 DELIVERY, STORAGE AND HANDLING:

A. Deliver hollow metal work cartoned or crated to provide protection during transit and job storage.

B. Inspect hollow metal work upon delivery for damage. Minor damages may be repaired provided the finish items are equal in all respects to new work and acceptable to the Architect; otherwise remove and replace damaged items as directed.

C. Store doors and frames at the building site under cover. Place units on at least 4" high wood sills or on floors in a manner that will prevent rust and damage. Avoid the use of non-vented plastic or canvas shelters which could create a humidity chamber. If the cardboard wrappers on doors become wet, remove carton immediately. Provide 1/4" spaces between stacked doors to promote air circulation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Hot-Rolled Steel Sheets and Strips: Commercial quality carbon steel, pickled and oiled, complying with ASTM A 569 and ASTM 568.

B. Cold-Rolled Steel Sheets: Commercial quality carbon steel, complying with ASTM A 366 and ASTM A 568.

C. Galvanized Steel Sheets: Zinc-coated carbon steel sheets of commercial quality, complying with ASTM A 526, with ASTM A 525, G90 zinc coating, mill phosphatized.

D. Supports and Anchors: Fabricate of not less that 16 gage sheet metal. Galvanize after fabrication units to be built into exterior walls, complying with ASTM A 153, Class B.

E. Inserts, Bolts and Fasteners: Manufacturer's standard units, except hot-dip galvanize items to be built into exterior walls, complying with ASTM A 153, Class C or D as applicable.

F. Shop-Applied Paint: Rust-inhibitive enamel or paint, either air-drying or baking, suitable as base for specified finish paints on steel surfaces.
2.02 FABRICATION, GENERAL:

A. Fabricate hollow metal units to be rigid, neat in appearance, and free from defects, warp or buckle. Accurately form metal to required sizes and profiles. Wherever practicable, fit and assemble units in the manufacturer's plant. Clearly identify work that cannot be permanently factory-assembled before shipment to assure proper assembly at the project site. Weld exposed joints continuously; grind, dress, and make smooth, flush, and invisible. Metallic filler to conceal manufacturing defects is not acceptable.

B. Exposed Fasteners: Unless otherwise indicated, provide countersunk flat Phillips or Jackson heads for exposed screws and bolts.

C. Finish Hardware Preparation:

1. Prepare hollow metal units to receive mortised and concealed finish hardware, including cutouts, reinforcing, drilling, and tapping in accordance with final Finish Hardware Schedule and templates provided by hardware supplier. Comply with applicable requirements of ANSI A 115 series specifications for door and frame preparation for hardware.

2. Reinforce hollow metal units to receive surface-applied hardware. Drilling and tapping for surface-applied finish hardware may be done at project site.

3. Locate finish hardware as shown on final shop drawings, or if not shown, in accordance with "Recommended Locations for Builder's Hardware", published by Door and Hardware Institute.

D. Shop Painting:

1. Clean, treat and paint exposed surfaces of fabricated hollow metal units, including galvanized surfaces.

2. Clean steel surfaces of mill scale, rust, oil, grease, dirt and other foreign materials before application of paint.

3. Apply pretreatment to cleaned metal surfaces, using cold phosphate solution (SSPC-PT-2), hot phosphate solution (SSPC-PT4) or basic zinc chromate-vinyl butyral solution (SSPC-PT3).
4. Apply shop coat or prime paint within time limits recommended by pretreatment manufacturer. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 2.0 mils, comply with ANSI A250.18.

E. Manufacturer: Provide hollow metal work by one of the following:

1. Ceco Door Products
2. Amweld Building Products
3. Steelcraft (A Division of Ingersoll-Rand)

2.03 FRAMES:

A. Provide hollow metal frames for doors, side-lights, borrowed lights, and other openings of sizes and profiles as indicated.

B. Fabricate frames of full-welded unit construction with corners mitered, reinforced, continuously welded full depth and width of frame, unless otherwise indicated.

1. Knock-down type frames are not acceptable.

C. Form frames of galvanized steel sheets for exterior and either cold or hot-rolled sheet steel for interior.

1. Gage: Not less than 14, for exterior openings up to and including 4'-0" wide.
2. Gage: Not less than 14, for interior openings up to and including 4'-0" wide.
3. For openings over 4'-0" wide: Not less than 12 gauge.

D. Finish Hardware Reinforcement: Reinforce frames for required finish hardware as follows:

1. Hinges and Pivots: Steel plate 3/16" thick x 1-1/2" wide x 6" longer than hinge, secured by not less than six spot-welds.
2. Strike Plate Clips: Steel plate 3/16" thick x 1-1/2" wide x 3" long.
3. Surface-Applied Closers: 12 gage steel sheet, secured with not less than six spot-welds.
4. Concealed Closers: Removable steel access plate, 12 gage internal reinforcement of size and shape required, and enclosing housing to keep closer pocket free of mortar or other materials.

E. Head Reinforcing: Where installed in masonry, leave vertical mullions in frames open at top for grouting.

F. Jamb Anchors: Furnish jamb anchors as required to secure frames to adjacent construction, formed of not less than 18 gage galvanized steel.

1. Masonry Construction: Adjustable, flat, corrugated or perforated T-shaped to suit frame size, with leg not less than 2" wide by 10" long. Furnish at least three anchors per jamb up to 7'-6" height; four anchors up to 8'-0" jamb height; one additional anchor for each 24" or fraction thereof over 8'-0" height.

2. Metal Stud Partitions: Insert type with notched clip to engage metal stud, welded to back of frames. Provide at least four anchors for each jamb for frames up to 7'-6" in height; five anchors up to 8'-0" jamb height; one additional anchor each 24" or fraction thereof over 8'-0" height.

G. Floor Anchors: Provide floor anchors for each jamb and mullion which extends to floor, formed of not less than 14 gage galvanized steel sheet as follows:

1. Monolithic Concrete Slabs: Clip type anchors with two holes to receive fasteners, welded to bottom of jambs and mullions.

H. Head Anchors: Provide two anchors at head of frames exceeding 42" wide for frames mounted in steel stud walls.

I. Head Strut Supports: Provide 3/8" x 2" vertical steel struts extending from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting construction above. Provide adjustable bolted anchorage to frame jamb members.

J. Structural Reinforcing Members: Provide as part of frame assembly, where indicated at mullions, transoms, or other locations which are to be built into frame.
K. Head Reinforcing: For frames over 4'-0" wide in masonry
wall openings, provide continuous steel channel or angle
stiffener not less than 12 gage for full width of opening
welded to back of frame at head.

L. Spreader Bars: Provide removable spreader bar across
bottom of frames, tack welded to jambs and mullions.

M. Rubber Door Silencers: Except on weatherstripped doors,
drill stops to receive three silencers on single-door
frames and four silencers on double door frames. Install
plastic plugs to keep holes clear during construction.

N. Plaster Guards: Provide 26 gage steel plaster guards or
dust cover boxes, welded to frame at back of finish
hardware cutouts where mortar or other materials might
obstruct hardware installation.

2.04 STOPS AND MOLDINGS:

A. Provide stops around glazed panels in hollow metal units
and in frames to receive doors where indicated.

B. Form fixed stops integral with frame, unless otherwise
indicated.

C. Provide removable stops and molds where indicated or
required, formed of not less than 20 gage steel sheets
matching steel on frames. Secure with countersunk machine
screws spaced uniformly not more than 12 o.c.. Form
corners with butted hairline joints.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Installer must examine substrate and conditions under
which hollow metal work is to be installed and must notify
the General Contractor, in writing, of any conditions
detrimental to proper and timely completion of the work.
Do not proceed with the work until unsatisfactory
conditions have been corrected in a manner acceptable to
Installer.

3.02 INSTALLATION:

A. Install hollow metal units and accessories in accordance
with final shop drawings, manufacturer's data, and as
herein specified.
B. Setting Masonry Anchorage Devices:

1. Provide masonry anchorage devices where required for securing hollow metal frames to concrete or masonry construction.

2. Set anchorage devices opposite each anchor location, in accordance with details on final shop drawings and anchorage device manufacturer's instructions. Leave drilled holes rough, not reamed, and free from dust and debris.

3. Floor anchors may be set with powder-actuated fasteners instead of masonry anchorage devices and machine screws, if so indicated on final shop drawings.

C. Placing Frames:

1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After all construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

2. Protective Coating: In masonry walls, protect inside (concealed) faces of door frames using fibered asphalt emulsion coating. Apply approximately 1/8" thick over shop primer and allow to dry before handling.

3. In masonry construction, building-in of anchors and grouting of frames is included in Section 04300 of these specifications.

4. Place frames at fire-rated openings in accordance with NFPA Standard No. 80.

5. Make field splices in frames as detailed on final shop drawings, welded and finished to match factory work.

6. Remove spreader bars only after frames or bucks have been properly set and secured.

D. Door Installation:

1. Fit hollow metal doors accurately in their respective frames with the following clearances:
   a. Jambs and Head: 3/32".
   b. Meeting Edges, Pairs of Doors: 1/8".
c. Bottom: 1/4" at threshold or carpet.
d. Bottom: 1/8" to bottom of head or transom panel.

2. Place fire-rated doors with clearances as specified in NFPA Standard No. 80.

3. Finish Hardware installation is specified in Section 08710.

3.03 ADJUST AND CLEAN:

A. Final Adjustments: Check and re-adjust operating finish hardware items in hollow metal work just prior to final inspection. Leave work in complete and proper operating conditions. Remove and replace defective work, including doors or frames which are warped, bowed or otherwise unacceptable.

B. Prime Coat Touch-Up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

END OF SECTION 08112
PART 1. GENERAL

1.1 SECTION INCLUDES: Wood doors non-rated and fire-rated
   A. Solid core flush wood doors

1.2 RELATED SECTIONS
   A. Section 06100 – Carpentry
   B. Section 06402 – Interior Architectural Woodwork
   C. Section 08710 – Finish hardware

1.3 REFERENCES AND REGULATORY REQUIREMENTS
   A. ASTM E152 - Methods of Fire Tests and Door Assemblies.
   B. NFPA 252 - Standard Methods for Fire Assemblies.
   C. UBC 7-2-1994
   D. UBC 7-2, 1997
   E. Michigan Building Code 2015
   F. UL 10 (c) - Fire Tests for Door Assemblies - Positive Pressure
   G. UL 10 (b) - Fire Tests for Door Assemblies - Neutral Pressure
   H. NFPA 80 - Fire Doors and Windows.
   I. Quality Standards:
      1. WDMA Industry Standard I.S. 1A-04
      2. ANSI A115. W Series, Wood Door Hardware Standards.
         (American National Standard Institute)
   K. Labeling Agencies
      1. Intertek Testing Services-Warnock Hersey (ITS-WH)
      2. Underwriters Laboratories (UL)

1.4 SUBMITTALS
   A. Shop drawings: Indicate location, size, and hand of each door; elevation of each kind of door; location and extent of hardware blocking; and other pertinent data.
      1. Indicate dimensions and locations of mortises and holes for hardware.
      2. Indicate dimensions and locations of cutouts.
      3. Indicate requirements for veneer matching.
      4. Indicate doors to be factory finished and finish requirements.
      5. Indicate fire ratings for fire doors.
B. Samples for Initial Selection: Color charts consisting of actual materials in small sections for the following:
   1. Faces for Factory Finished doors: Show the full range of colors available for stained finishes.

C. Samples for Verification:
   1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide one piece of the expected finished work.

1.5 QUALITY ASSURANCE

A. Source limitations: Obtain flush wood doors through one source from a single manufacturer.

B. Quality standard: Comply with WDMA I.S.1-A 04

C. Fire-rated Doors: Doors complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UBC 7-2-1997 (Positive Pressure)

1.6 DELIVERY STORAGE AND HANDLING AND SITE CONDITIONS

A. Deliver, store, protect and handle products under provisions of WDMA.

B. Package doors individually and wrap bundles of doors. Inspect for damage. Do not store in damp or wet areas. HVAC systems should be operating and balanced prior to arrival of doors. Acceptable humidity shall be no less than 25% nor greater than 55%.

C. Certain wood species are light sensitive. Protect doors from exposure to natural and artificial light after delivery.

1.7 WARRANTY

A. Provide manufacturer's warranty for Interior Solid Core Doors:
   1. Full Lifetime Warranty
PART 2. PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:
   1. Flush wood doors:
      a. Algoma Hardwoods, Inc.
      b. Eggers Industries
      c. Poncraft Door Company
      d. Graham Manufacturing Corporation
      e. Marshfield Door Systems Signature Series (Basis of Design)

B. Substitutions allowed only with written approval by architect prior to bid date.

2.2 DOOR CONSTRUCTION, GENERAL

A. WORKMANSHP
   1. Comply with WDMA I.S. 1A-04

B. PERFORMANCE STANDARD
   1. Comply with WDMA I.S. 1A-04 Extra Heavy Duty

C. DOORS FOR TRANSPARENT FINISH:
   1. Grade: Premium, with A Grade Faces
   2. Wood veneer Species and Cut:
      a. rift cut red oak.
   3. Match between veneer leaves: Book match
   4. Assembly of spliced veneers: Running
   5. Pair and Set match: Provide for doors hung in same opening or separated only by mullions.
   6. Door with Transom: Continuous match

D. DOORS FOR OPAQUE FINISH:
   1. Medium Density Overlay

E. Interior Veneer-faced doors:
   1. Stiles and rails bonded to core, then entire unit abrasive planed before veneering.
F. Rating: Positive pressure Category A (concealed intumescent).

2.3 SOLID-CORE DOORS

A. NON-FIRE RATED WOOD DOORS

1. Non-rated and 20-minute rated
   a. LD-2 Particleboard, PC-5

2. Provide manufacturers standard laminated-edge construction with improved screw-holding capability and split resistance.

3. 20-minute rated pairs:
   a. Provide with fire-retardant stiles matching face veneer that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals.
   b. As required by manufacturer to permit positive pressure “S” label per Category H.

B. FIRE RATED WOOD DOORS

1. Manufacturer’s standard mineral-core construction as needed to provide fire rating indicated.

2. Blocking: provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated as needed to eliminate through-bolting hardware for surface applied hardware.

3. Provide manufacturers standard laminated-edge construction with improved screw-holding capability and split resistance that are labeled and listed to provide fire rating indicated.


C. Acoustic Rated Doors

1. Provide core indicated or special construction core as required to meet STC 47 rating, all STC ratings must be
2. Provide gasketing and door bottom as required to meet manufacturer’s tested acoustic rating.
3. Hollow metal frames shall be fully grouted or packed with mineral wool where acoustic rated doors are installed.
4. The sound transmission class (STC) specified shall be certified by the manufacturer to be based on tests conducted at an independent testing conducted agency in accordance with ASTM E 90-90 and E 413-87.

2.4 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
   1. WDMA prefit clearances for factory fit doors
   2. NFPA 80 for fire rated doors
   3. Manufacturers hardware templates

B. Factory machine doors for hardware that is not surface applied. Comply with final hardware schedules, door frame Shop Drawings, and hardware templates.
   1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standard for kind(s) of doors(s) required.
   1. Light openings: Trim openings with moldings of material and profile indicated.
   2. Louvers: Factory install louvers in prepared openings.

D. Apply appropriate labels.

2.5 FACTORY FINISH

A. General: Comply with WDMA finish requirements.

B. Finish doors at factory.

D. Transparent Finish:
1. Finish: WDMA TR-6 catalyzed polyurethane.
2. Staining: As selected from manufacturers standard colors.

E. Factory finished doors to be installed just prior to substantial completion.

2.6 FACTORY GLAZING

A. Glazing in wood doors to be installed by wood door manufacturer.

2.7 ACCESSORIES

A. GLAZING STOPS
   1. Non-Rated:
      a. Wood, of the same species/compatible with door species.
   2. Fire-Rated:
      a. Veneer wrapped rolled steel, of same species as door facing.

B. APPLIED MOLDINGS:
   1. As selected from manufacturer’s standard profiles and install as detailed.
   2. Applied moldings to be affixed to the door without the use of nails or staples.

PART 3. EXECUTION

3.1 EXAMINATION

A. Examine doors and installed frames before hanging doors.
   1. Verify that frames comply with indicated requirements for type, size, location and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects prior to hanging.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Hardware: For installation, Refer to Division 8 Section 08710 “Finish Hardware.”

B. Manufacturer’s written instructions: Install doors to comply with manufacturer’s written instructions, referenced quality standard, and as indicated.
   1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Align all doors for uniform clearance at each edge.

D. Factory finished doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Adjust all doors to swing and operate freely.

END OF SECTION 08210
1.01 RELATED DOCUMENTS:
   A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:
   A. The extent, location and size of each type of access door required are shown on the drawings.
   B. Related work specified elsewhere:
      1. Division 15 Mechanical
      2. Division 16 Electrical

1.03 QUALITY ASSURANCE:
   A. Fire-Resistance Ratings: Wherever a fire-resistance classification is indicated, provide access door assembly with panel door, frame, hinge, and latch from manufacturer listed in Underwriters’ Laboratories, Inc. “Classified Building Materials Index” for the rating shown.
      1. Provide UL label on each fire-rated access door.
   B. Size Variations: Obtain Architects’ acceptance of manufacturer’s standard size units which may vary slightly from sizes indicated.
   C. Manufacturer: Provide access doors as manufactured by one of the following:
      1. Larsens
      2. Karp Associates Inc.
      3. Milcor
      4. Babcock Davis
   D. Inserts and Anchorages:
      1. Furnish inserts and anchoring devices which must be built into other work for the installation of access doors. Coordinate delivery with other work to avoid delay.
1.04 SUBMITTALS:

A. Manufacturer’s Data:

1. For information only, submit 2 copies of manufacturer's technical data and installation instructions for each type of access door assembly. Transmit copy of each instruction to the Installer.

   a. Provide setting drawings, templates, instructions and directions for installation of anchorage devices.

PART 2 - PRODUCTS

2.01 MATERIALS & FABRICATION:

A. General: Furnish access door assemblies manufactured as an integral unit, complete with all parts and ready for installation.

B. Steel Access Doors and Frames: Fabricate units of continuous welded steel construction, unless otherwise indicated. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of the type required to secure access panels to the types of support shown.

C. Frames:

1. Fabricate from 12 gauge steel. (16 gauge for ceiling applications, 10 gauge for all security areas)

2. Fabricate frame with exposed flange approximately 1” wide around perimeter of frame for units installed in the following construction.
   a. Exposed masonry.
   b. Drywall finish.

3. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.
D. Flush Panel Doors:
   1. Fabricate from not less than 12 gage sheet steel with concealed spring hinges set to open to 175 degrees. Finish with manufacturer’s factory-applied prime paint. Hot dip galvanize (per ASTM A123) which are to be installed on the exterior.
   2. Provide flush panel doors, unless otherwise indicated.
   3. For fire-rated units, provide manufacturer’s standard insulated flush panel doors.

E. Locking Devices:
   1. Interior: Furnish flush, spanner head cam locks of the number required to hold door in flush, smooth plane when closed.
   2. Exterior: Furnish flush, mortise locks of the number required to hold door in a flush smooth plane when closed.

F. Schedule: Provide the following types of access panels. (basis of design is Larsens)
   1. Wall Applications: Model L-DPM (Provide L-DPH in maximum security areas and other areas as indicated on drawings) minimum size 18”H x 18”W unless noted otherwise on drawings with masonry anchors where required and prep for mortise lock provided by Larsens. Provide where indicated on mechanical/electrical/architectural drawings or required by code to access existing/new valves, junction boxes, etc.
   2. Ceiling Application: Model L-DWR minimum size 24” x 24” with prep for mortise lock provided by Larsens. Provide where indicated on mechanical/electrical drawings or required by code to access existing/new valves, junction boxes, etc.
   3. At fire rated locations provide model L-DPFB (with masonry anchors for wall applications where required) and prep for mortise lock provided by Larsens. 12” x 12” minimum for wall applications. Rating shall be min. B label (1 ½ hour).
PART 3 - EXECUTION

3.01 INSPECTION:

A. Installer must examine the conditions under which access doors are to be installed and notify the General Contractor, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 INSTALLATION:

A. Comply with manufacturer's instructions for installation of access doors.

B. Coordinate installation with work of other trades.

C. Set frames accurately in position and securely attach to supports with face panels plumb or level in relation to adjacent finish surfaces.

D. Adjust hardware and panels after installation for proper operation.

E. Remove and replace panels or frames which are warped, bowed or otherwise damaged.

END OF SECTION 08305
1. GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and General Provisions of contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work in this section.

1.2. DESCRIPTION OF WORK

A. The extent of each type of door and frame is shown on the drawings and in schedules.

B. The following types of doors and frames are required:
   1. FRP flush doors
   2. Aluminum frames for flush FRP doors.

1.3. RELATED WORK SPECIFIED ELSEWHERE

A. For Finish Hardware, see Section 08710.
B. For Sealants & Caulking, see Section 07920.
C. Aluminum Framed Storefronts - See Section 08413
D. Aluminum Framed Entrance Doors - See Section 08421
E. For Glass & Glazing, see Section 08800.

1.4. SYSTEM PERFORMANCE
FRP AND ALUMINUM FLUSH DOORS

A. Provide door assemblies that have been designed and fabricated to comply with requirements for system performance characteristics listed below, as demonstrated by testing manufacturer's corresponding stock systems according to test methods designated.

B. Thermal Transmission (exterior doors); U-value of not more than 0.09 (BTU/Hr. x sf x degrees F.) per AAMA 1503.01.

C. Flame Spread/Smoke Developed: Provide FRP doors and panels with
the following ratings in accordance with ASTM E 84-79a: Flame Spread: Exterior faces not greater than 145 (Class C); interior faces not greater than 10 (Class A). Smoke Developed: Exterior faces not greater than 345 (Class C); interior faces not greater than 320 (Class A).

D. Additional Criteria: Provide FRP doors and panels with the following performance:

- ASTM D 256 - nominal value of 13.5
- ASTM D 1242 - nominal value of .23 percent
- ASTM D 570 - nominal value of .20 to .40 percent
- ASTM D 2583 - nominal value of 50

1.5. QUALITY ASSURANCE - ALL BIDDERS SHALL BE FACTORY DIRECT AUTHORIZED DISTRIBUTORS OF THE SPECIFIED PRODUCTS.

A. Standards: Comply with the requirements and recommendations in applicable specification and standards by NAAMM and AAMA, including the terminology definitions and specifically including the "Entrance Manual" by NAAMM, except to the extent more stringent requirements are indicated.

B. Performance: A minimum ten year record of production of frames, doors and panels and completion of similar projects in type and size.

C. Instruction: The manufacturer or his representative will be available for consultation to all parties engaged in the project including instruction to installation personnel.

D. Field Measurement: Field verify all information prior to fabrication and furnish of materials. Furnish and install materials omitted due to lack of verification at no additional cost to Owner.

E. Regulation and Codes: Comply with the current edition in force at the project location of all local, state and federal codes and regulations, including the Americans with Disabilities Act of 1992.

1.6. SUBMITTALS

A. Product Data: Submit Manufacturer's product data,
specifications and instructions for each type of door and frame required in accordance with Section 01300 and the following:

1. Include details of core, stile and rail construction, trim for lites and all other components.

2. Include details of finish hardware mounting.

3. Include sample of each aluminum alloy to be used on this project. Where normal finish color and texture variations are expected, include two or more samples to show the range of such variations.

4. Include one sample of typical fabricated section, showing joints, fastenings, quality of workmanship, hardware and accessory items before fabrication of the work proceeds.

B. Submit shop drawings for the fabrication and installation of the doors and frames, and associated components. Details to be shown full scale. Include glazing details and finish hardware schedule.

1.7. PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver materials to jobsite in their original, unopened packages with labels intact. Inspect materials for damage and advise manufacturer immediately of any unsatisfactory materials.

B. Package door assemblies in individual corrugated cartons so no portion of the door has contact with the outer shell of the container. Package and ship frames preassembled to the greatest possible extent.

1.8. PROJECT WARRANTY

A. Provide a written warranty signed by manufacturer, installer and contractor, agreeing to replace, at no cost to the Owner, any doors, frames or factory hardware installation which fail in materials or workmanship, within the warranty period. Failure of materials or workmanship includes: excessive
deflection, faulty operation of entrances, deterioration of finish, or construction in excess of normal weathering and defects in hardware installation. The minimum time period of warranty is ten (10) years from acceptance.

2. PRODUCTS

2.1. ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of the following:

2.2. MATERIALS AND ACCESSORIES

A. Aluminum Members: Alloy and temper as recommended by manufacturer for strength, corrosion resistance and application of required finish and control of color; ASTM B 221 for extrusions, ASTM B 209 for sheet/plate with aluminum wall thickness of 0.125".

B. Components: Furnish door and frame components from the same manufacturer. "Splitting" of door and frame components is not permitted.

C. Fasteners: Aluminum non-magnetic stainless steel or other non-corrosive metal fasteners, guaranteed by the manufacturer to be compatible with the doors, frames, stops, panels, hardware, anchors and other items being fastened. For exposed fasteners (if any) provide oval Phillips head screws with finish matching the item to be fastened.

D. Glazing Gaskets: For glazing factory-installed glass, and for gaskets which are factory-installed in "captive" assembly of glazing stops. Manufacturer's standard stripping of molded neoprene, complying with ASTM D 2000 (Designation 2BC415 to 3BC620), or molded PVC complying with ASTM C 509 Grade 4.

2.3. FABRICATION

A. Sizes and Profiles: The required sizes for door and frame units,
and profile requirements are shown on the drawings.

B. Coordination of Fabrication: Field measure before fabrication, and show recorded measurements on final shop drawings.

C. Complete the cutting, fitting, forming, drilling and grinding of all metal work prior to assembly. Remove burrs from cut edges, and ease edges and corners to a radius of approximately 1/64”.

D. No welding of doors or frames is acceptable.

E. Maintain continuity of line and accurate relation of planes and angles. Secure attachments support at mechanical joints, with hairline fit at contacting members.

F. Attachment of all hardware shall be made using machine screws which are supplied by the manufacturer.

G. All holes shall be drilled and tapped using the recommended drill size for the tap required.

H. Frames stops shall be applied stops, Minimum 5/8” high x Minimum 1 ¼” wide.

I. Door attachment points shall be minimum of 1/8” thickness.

J. Where hardware is to be attached to frame stop (Example: exit device strike, door closer shoe, O.H. stop & Etc.) a piece of solid bar stock aluminum sized to fill the frame stop void x 18” long shall be securely attached to the frame tube.

K. Where it is practical to have solid bar stock reinforcement at attachment points, use “RIV-NUTS for attachment of hardware items.

2.4. FIBERGLASS REINFORCED POLYESTER FRP FLUSH DOORS

A. Materials and Construction

1. Construct 1 ¾ inch thickness doors of 6063 T5 aluminum alloy stiles and rails minimum 25/16 inch dept. Provide joinery of 3/8 inch diameter full width tie rods through extruded splines top and bottom as standard .125 inch tubular shaped stiles and rails reinforced to accept hardware as specified.
2. Extrude top and bottom rail legs for interlocking continuous rail rigidity weather bar. Lock face sheet material in place with extruded interlocking edges to be flush with aluminum stiles and rails.


5. Manufacture doors with cutouts for visor-lites, louvers or panels as scheduled. Factory furnish and install all glass, louvers and panels prior to shipment.

6. Premachine doors in accordance with templates from the specified hardware manufacturers and approved hardware schedule. Factory install hardware.

7. Furnish FRP doors with flush pull SL86. Color as selected by the Architect.

8. Provide door with adjustable brush insert.

2.5. ALUMINUM FRAMING SYSTEMS (For flush FRP doors)

A. Tubular Framing

1. Framing system from the door manufacturer of the size and type shown. .125" minimum wall thickness and type 6063-T5 aluminum alloy .625" high applied stops with screws and weather-stripping. Frame members are to be box type with four (4) enclosed sides. Open back framing will not be acceptable.

2. Caulk joints before assembling frame members. Secure joints with fasteners and provide a hairline butt joint appearance. Prefit doors to frame assembly at factory prior to shipment. Field fabrication of framing using "stick" material is not
acceptable.

3. Applied stops for side, transom and borrowed lites and panels, with fasteners exposed on interior or unsecure portion only. Premachine and reinforce frame members for hardware in accordance with manufacturer's standards and the approved hardware schedule. Factory install hardware.

4. Anchors appropriate for wall conditions to anchor framing to wall materials. A minimum of five anchors up to 7'4" on jamb members, and one additional anchor for each foot over 7'4". Secure head and sill members of transom, sidelites and similar conditions.

5. Factory pre-assemble sidelites to the greatest extent possible, and mark frame assemblies according to location.

6. Refer to Section 08710 for removable mullions which shall be furnished and installed by this Contractor. Finish of removable mullions to match frames.

2.6. GLAZING

A. Design system for replacement of glass.

1. Manufacturer's standard flush glazing system of recessed channels and captive glazing gaskets or applied stops as shown.

2. Allow for thermal expansion on exterior units.

3. Glass as shown and factory glazed into doors.

4. Provide 1" insulated low “E” glass units. Refer to Spec Section 08800 for additional information.

2.7 ALUMINUM FINISHES

A. All exposed aluminum to be factory finished with AZKO Nobel “Trinar”, color to be determined from manufacturer’s standard and/or custom colors by Architect.

3. EXECUTION

3.1. INSTALLATION
A. Comply with manufacturer's recommendations (maintain 3/16" gap between leafs of pairs of doors) and specifications for the installation of the doors and frames. Factory install hardware, glass and louvers in doors. Factory assemble sidelites and transoms to the greatest extent possible.

B. Set units plumb, level and true to line, without warp or rack of doors or frames. Anchor securely in place. Separate aluminum and other metal surfaces with bituminous coatings or other means as approved by architect.

C. Set thresholds in a bed of mastic and backseal.

D. Clean surfaces promptly after installation of doors and frames, exercising care to avoid damage to the protective coatings.

E. Ensure that the doors and frames will be without damage or deterioration (other than normal weathering) at the time of acceptance.

F. Provide Owner with all adjustment tools and instruction sheets. Arrange an inservice session to Owner at Owner's convenience. Any workmanship which is defective or deficient shall be corrected to the Owner's satisfaction and at no additional cost to the Owner per Paragraph 1.8 Project Warranty of this specification.

END OF SECTION 08410
SECTION 08413 - ALUMINUM-FRAMED STOREFRONTS

PART 1 - GENERAL

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

1.2 Summary
A. Section Includes: Kawneer Architectural Aluminum Storefront Systems, including perimeter trims, stools, accessories, shims and anchors, and perimeter sealing of storefront units.

1. Types of Kawneer Aluminum Storefront Systems include:
   a. Trifab™ VG 451T Framing System - 2" x 4-1/2" (50.8 mm x 114.3 mm) nominal dimension; Thermal; Front, Center, Back, Multi-Plane, Structural Silicone or Weatherseal Glazed (Type B); Screw Spline, Shear Block, Stick or Punched Opening Fabrication.

B. Related Sections:
   1. 07920 “Joint Sealants”
   2. 08410 “FRP Doors – Aluminum Framing Systems”
   3. 08421 “Aluminum Framed Entrance Doors”
   4. 08520 “Aluminum Windows” Fixed, Sliding
   5. 08800 “Glass and Glazing”

1.3 Definitions
A. Definitions: For fenestration industry standard terminology and definitions refer to American Architectural Manufacturers Association (AAMA) - AAMA Glossary (AAMA AG).

1.4 Performance Requirements
A. Storefront System Performance Requirements:
   1. Wind loads: Provide storefront system; include anchorage, capable of withstanding wind load design pressures of 23 lbs./sq. ft. inward and 23 lbs./sq. ft. outward. The design pressures are based on the Michigan Building Code; 2015 Edition.
2. Air Leakage: The test specimen shall be tested in accordance with ASTM E 283. Air Leakage rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 6.2 psf (300 Pa) with interior seal, or, rate shall not exceed 0.06 cfm/ft² (0.3 l/s · m²) at a static air pressure differential of 1.6 psf (75 Pa) without interior seal. CSA A440 Fixed Rating.

3. Water Resistance: The test specimen shall be tested in accordance with ASTM E 331. There shall be no leakage at a minimum static air pressure differential of 8 psf (383 Pa) as defined in AAMA 501.

4. Uniform Load: A static air design load of 35 psf (1680 Pa) shall be applied in the positive and negative direction in accordance with ASTM E 330. There shall be no deflection in excess of L/175 of the span of any framing member. At a structural test load equal to 1.5 times the specified design load, no glass breakage or permanent set in the framing members in excess of 0.2% of their clear spans shall occur.

5. Seismic: When tested to AAMA 501.4, system must meet design displacement of 0.010 x the story height and ultimate displacement of 1.5 x the design displacement.

6. Thermal Movements: Allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures:
   a. Temperature Change (Range): 0 deg F (-18 deg C); 180 deg F (82 deg C).
   b. Test Interior Ambient-Air Temperature: [75 deg F (24 deg C)].
   c. Test Performance: No buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5 for a minimum 3 cycles.

7. Thermal Transmittance (U-factor): When tested to AAMA Specification 1503, the thermal transmittance (U-factor) shall not be more than:
   a. Glass to Exterior - 0.47 (low-e).
   b. Glass to Center - 0.44 (low-e).
   c. Glass to Interior - 0.41 (low-e).

8. Condensation Resistance (CRF): When tested to AAMA Specification 1503, the condensation resistance factor shall not be less than:
   a. Glass to Exterior - 70_{frame} and 69_{glass} (low-e).
   b. Glass to Center - 62_{frame} and 68_{glass} (low-e).
   c. Glass to Interior - 56_{frame} and 67_{glass} (low-e).
9. Sound Transmission Class (STC) and Outdoor-Indoor Transmission Class (OITC): When tested to AAMA Specification 1801 and in accordance with ASTM E1425 and ASTM E90, the STC and OITC Rating shall not be less than:
   a. Glass to Exterior – 38 (STC) and 31 (OITC).
   b. Glass to Center – 37 (STC) and 30 (OITC).
   c. Glass to Interior – 38 (STC) and 30 (OITC).

1.5 Submittals

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, hardware, finishes, and installation instructions for each type of aluminum-framed storefront system indicated.

B. Shop Drawings: Include plans, elevations, sections, details, hardware, and attachments to other work, operational clearances and installation details.

C. Samples for Initial Selection: For units with factory-applied color finishes including samples of hardware and accessories involving color selection.

D. Samples for Verification: For aluminum-framed storefront system and components required.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for each type of aluminum-framed storefront.

F. Fabrication Sample: Of each vertical-to-horizontal intersection of aluminum-framed systems, made from 12" (304.8 mm) lengths of full-size components and showing details of the following:
   1. Joinery.
   2. Anchorage.
   5. Flashing and drainage.

G. Other Action Submittals:
   1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.
1.6 Quality Assurance

A. Installer Qualifications: An installer which has had successful experience with installation of the same or similar units required for the project and other projects of similar size and scope.

B. Manufacturer Qualifications: A manufacturer capable of providing aluminum-framed storefront system that meet or exceed performance requirements indicated and of documenting this performance by inclusion of test reports, and calculations.

C. Source Limitations: Obtain aluminum-framed storefront system through one source from a single manufacturer.

D. Product Options: Drawings indicate size, profiles, and dimensional requirements of aluminum-framed storefront system and are based on the specific system indicated. Refer to Division 01 Section “Product Requirements”. Do not modify size and dimensional requirements.

1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect’s approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockup for type(s) of storefront elevation(s) indicated, in location(s) shown on Drawings.

F. Pre-installation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section “Project Management and Coordination”.


H. Structural-Sealant Joints: Design reviewed and approved by structural-sealant manufacturer.

1.7 Project Conditions

A. Field Measurements: Verify actual dimensions of aluminum-framed storefront openings by field measurements before fabrication and indicate field measurements on Shop Drawings.
1.8 Warranty

A. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty.

1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by manufacturer.

PART 2 - PRODUCTS

2.1 Manufacturers

A. Basis-of-Design Product:
   1. Kawneer Company Inc.
   2. Trifab™ 451T (Thermal) Framing System
   3. System Dimensions: 2” x 4-1/2” (50.8 mm x 114.3 mm)
   4. Glass: Center, Exterior or Interior

B. Subject to compliance with requirements, provide a comparable product by the following manufacturers:
   1. Efco
   2. Graham
   3. Wausau
   4. Peerless

C. Substitutions: Refer to Substitutions Section for procedures and submission requirements
   1. Pre-Contract (Bidding Period) Substitutions: Submit written requests ten (10) days prior to bid date.
   2. Post-Contract (Construction Period) Substitutions: Submit written request in order to avoid storefront installation and construction delays.
   3. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.
   4. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for storefront system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of aluminum storefronts for a period of not less than ten (10) years. (Company Name)
   5. Test Reports: Submit test reports verifying compliance with each test requirement required by the project.
   6. Samples: Provide samples of typical product sections and finish samples in manufacturer's standard sizes.
D. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Owner and Contractor.

2.2 Materials

A. Aluminum Extrusions: Alloy and temper recommended by aluminum storefront manufacturer for strength, corrosion resistance, and application of required finish and not less than 0.070" (1.8 mm) wall thickness at any location for the main frame and complying with ASTM B 221: 6063-T6 alloy and temper.

B. Fasteners: Aluminum, nonmagnetic stainless steel or other materials to be non-corrosive and compatible with aluminum framing members, trim hardware, anchors, and other components.

C. Anchors, Clips, and Accessories: Aluminum, nonmagnetic stainless steel, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.

D. Reinforcing Members: Aluminum, nonmagnetic stainless steel, or nickel/chrome-plated steel complying with ASTM B 456 for Type SC 3 severe service conditions, or zinc-coated steel or iron complying with ASTM B 633 for SC 3 severe service conditions or other suitable zinc coating; provide sufficient strength to withstand design pressure indicated.

E. Sealant: For sealants required within fabricated storefront system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.

F. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of storefront members are nominal and in compliance with AA Aluminum Standards and Data.

2.3 Storefront Framing System

A. Thermal Barrier (Trifab™ VG 451T):
   1. Kawneer IsoLock™ Thermal Break with a 1/4" (6.4 mm) separation consisting of a two-part chemically curing, high-density polyurethane, which is mechanically and adhesively joined to aluminum storefront sections.
      a. Thermal Break shall be designed in accordance with AAMA TIR-A8 and tested in accordance with AAMA 505.
B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials. Where exposes shall be stainless steel.

D. Perimeter Anchors: When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

E. Packing, Shipping, Handling and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

F. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle storefront material and components to avoid damage. Protect storefront material against damage from elements, construction activities, and other hazards before, during and after storefront installation.

2.4 Glazing Systems

A. Glazing: As specified in Section 08800 “Glass & Glazing”.

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

E. Glazing Sealants: For structural-sealant-glazed systems, as recommended by manufacturer for joint type, and as follows:
   1. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural-sealant manufacturer for use in aluminum-framed systems indicated.
       a. Color: Black
   2. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact;
recommended by structural-sealant, weatherseal-sealant, and aluminum-framed-system manufacturers for this use.


2.5 Entrance Door Systems

A. Entrance Doors: As specified in Section 08421 “Aluminum-Framed Entrance Doors”.

B. Entrance Door Hardware: As specified in Section 08710 “Door Hardware”.

2.6 Accessory Materials

A. Joint Sealants: For installation at perimeter of aluminum-framed systems, as specified in Section 07920 “Joint Sealants”.

B. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30 mil (0.762 mm) thickness per coat.

2.7 Fabrication

A. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fit joints; make joints flush, hairline and weatherproof.
   3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
   4. Physical and thermal isolation of glazing from framing members.
   5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

B. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

C. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

D. Storefront Framing: Fabricate components for assembly using manufacturer’s standard installation instructions.
E. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 Aluminum Finishes

A. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

B. Factory Finishing:
   1. Fluoropon™ (70% PVDF), AAMA 2605, Fluoropolymer Coating (Color to be determined. Selected from manufacturers standard and/or custom colors).

PART 3 - EXECUTION

3.1 Examination

A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather tight framed aluminum storefront system installation.
   1. Masonry Surfaces: Visibly dry and free of excess mortar, sand, and other construction debris.
   2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches (76 mm) of opening.
   3. Metal Surfaces: Dry; clean; free of grease, oil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
   4. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 Installation

A. Comply with Drawings, Shop Drawings, and manufacturer's written instructions for installing aluminum-framed storefront system, accessories, and other components.
B. Install aluminum-framed storefront system level, plumb, square, true to line, without distortion or impeding thermal movement, anchored securely in place to structural support, and in proper relation to wall flashing and other adjacent construction.

C. Set sill members in bed of sealant or with gaskets, as indicated, for weather tight construction.

D. Install aluminum-framed storefront system and components to drain condensation, water penetrating joints, and moisture migrating within aluminum-framed storefront to the exterior.

E. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials.

3.3 Field Quality Control

A. Field Tests: Architect shall select storefront units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer's representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.

1. Testing: Testing shall be performed by a qualified independent testing agency. Refer to Testing Section for payment of testing and testing requirements. Testing Standard per AAMA 503, including reference to ASTM E 783 for Air Infiltration Test and ASTM E 1105 Water Infiltration Test.

   a. Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.09 cfm/ft², whichever is greater.

   b. Water Infiltration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 6.2 psf (300 Pa).

B. Manufacturer's Field Services: Upon Owner’s written request, provide periodic site visit by manufacturer’s field service representative.
3.4 Adjusting, Cleaning, and Protection

A. Clean aluminum surfaces immediately after installing aluminum-framed storefronts. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

B. Clean glass immediately after installation. Comply with glass manufacturer's written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

END OF SECTION 08413
SECTION 08421 - ALUMINUM-FRAMED ENTRANCE DOORS

PART 1 - GENERAL

1.01 Summary

A. Section Includes: Kawneer Aluminum Entrances, glass and glazing, and door hardware and components.

1. Types of Kawneer Aluminum Entrances include:
   a. 350 Heavy Wall™ Door; Medium stile, 3-1/2" (89) vertical face dimension, 2" (51) depth, 3/16" (5) wall thickness, high traffic applications.

B. Related Sections:
   1. Section 08410 "FRP Doors – Aluminum Framed Systems"
   2. Section 08413 “Aluminum Framed Entrances & Storefronts”
   3. Section 08710 "Hardware"
   4. Section 08800 "Glass & Glazing"

1.02 References (Industry Standards)

1.03 System Description

A. Entrance Performance Requirements:
   1. Air Infiltration: For single acting offset pivot or butt hung entrances in the closed and locked position, the test specimen shall be tested in accordance with ASTM E 283 at a pressure differential of 6.24 psf (300 Pa) for single doors and 1.567 psf (75) for pairs of doors. A single 3'0" x 7'0" (915 x 2134) entrance door and frame shall not exceed 0.50 cfm per square foot. A pair of 6'0" x 7'0" (1830 x 2134) entrance doors and frame shall not exceed 1.0 cfm per square foot.
   2. Structural: Corner strength shall be tested per the Kawneer dual moment load test procedure and certified by an independent testing laboratory to ensure weld compliance and corner integrity [Testing procedure and certified test results available upon request].

1.04 Submittals

A. General: Prepare, review, approve, and submit specified submittals in accordance with “Conditions of the Contract” and Submittals Sections. Product data, shop drawings,
samples, and similar submittals are defined in “Conditions of the Contract.”

B. Quality Assurance/Control Submittals:

1. Test Reports: Submit certified test reports showing compliance with specified performance characteristics.

1.05 Warranty

A. Project Warranty: Refer to “Conditions of the Contract” for project warranty provisions.

B. Manufacturer’s Product Warranty: Submit, for Owner’s acceptance, manufacturer’s warranty for entrance system as follows:

1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by Kawneer. In addition, welded door corner construction shall be supported with a limited lifetime warranty for the life of the door under normal use.

1.06 Quality Assurance

A. Qualifications:

1. Installer Qualifications: Installer experienced (as determined by contractor) to perform work of this section who has specialized in the installation of work similar to that required for this project and who is acceptable to product manufacturer.

2. Manufacturer Qualifications: Manufacturer capable of providing structural calculations, applicable independent product test reports, installation instructions, a review of the application method, customer approval and periodic field service representation during construction.

3. On access control installations, all wiring to be coordinated with a licensed electrical installer.
B. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer’s installation instructions, and manufacturer’s warranty requirements.

1.07 Delivery, Storage and Handling

A. Ordering: Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.

B. Packing, Shipping, Handling, and Unloading: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful weather conditions. Handle entrance doors and components to avoid damage. Protect entrance doors against damage from elements, construction activities, and other hazards before, during and after entrance installation.

PART 2 – PRODUCTS

2.01 Manufacturers

A. Acceptable Manufacturers:

1. Address: Kawneer Company, Inc.
   555 Guthridge Court,
   Technology Park/Atlanta,
   Norcross, GA 30092
   Telephone: 770 449 5555
   Fax: 770 734 1560

2. Finish/Color: (See 2.06 Finishes)
B. Aluminum Framed Entrance Doors specifications and design details are based on Kawneer as indicated above. Other manufacturers that are acceptable provided their product meets all comparable design details sizes, requirements and sunshade requirements are:

1. EFCO
2. Wausau
3. Graham
4. Peerless

C. Substitutions:

1. General: Refer to Substitutions Section for procedures and submission requirements.
   a. Pre-Contract (Bidding Period) Substitutions: Submit written requests ten (10) days prior to bid date.
   b. Post-Contract (Construction Period) Substitutions: Submit written request in order to avoid curtain wall installation and construction delays.

2. Substitution Documentation
   a. Product Literature and Drawings: Submit product literature and drawings modified to suit specific project requirements and job conditions.

   b. Certificates: Submit certificate(s) certifying substitute manufacturer (1) attesting to adherence to specification requirements for curtain wall system performance criteria, and (2) has been engaged in the design, manufacturer and fabrication of aluminum curtain wall for a period of not less than ten (10) years. (Company Name)

   c. Test Reports: Submit test reports verifying compliance with each test requirement for curtain wall required by the project.

   d. Product Sample and Finish: Submit product sample, representative of curtain wall for the project, with specified finish and color.

3. Substitution Acceptance: Acceptance will be in written form, either as an addendum or modification, and documented by a formal change order signed by the Owner and Contractor.

2.02 Materials
A. Aluminum (Entrances and Components):

1. Material Standard: ASTM B 221; 6063-T6 alloy and temper
2. The door shall be 2" thick and stile and rail face dimensions of:
<table>
<thead>
<tr>
<th>Door</th>
<th>Vertical Stile</th>
<th>Top Rail</th>
<th>Bottom Rail</th>
</tr>
</thead>
<tbody>
<tr>
<td>350 Heavy Wall</td>
<td>3-1/2&quot; (89)</td>
<td>3-17/32&quot; (90)</td>
<td>6-1/2&quot; (166)</td>
</tr>
</tbody>
</table>
3. Major portions of the door members to be 0.188" (5) nominal in thickness and glazing molding to be 0.05" (1.5) thick.
4. Tolerances: Reference to tolerances for wall thickness and other cross-sectional dimensions of entrance members are nominal and in compliance with Aluminum Standards and Data, published by The Aluminum Association.

B. Glazing gaskets shall be either EPDM elastomeric extrusions or a thermoplastic elastomer.

C. Provide adjustable glass jacks to help center the glass in the door opening.

2.03 Accessories

A. Fasteners: Where exposed, shall be aluminum, stainless steel or plated steel.

B. Perimeter Anchors: Aluminum. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

C. Standard 350 Heavy Wall™ Entrance Hardware.

1. Refer to Section 08710 for Hardware Equipment.
2. The Finish Hardware supplier shall be responsible for furnishing physical hardware to the entrance manufacturer prior to fabrication.

2.04 Related Materials

A. Sealants: Refer to “Joint Treatment” (Sealants) Section 07920
B. Glass: Refer to “Glass and Glazing” Section 08800

2.05 Fabrication

A. Entrance System Fabrication:

1. Door corner construction shall consist of mechanical clip fastening, SIGMA deep penetration plug welds and 1-1/8" (29) long fillet welds inside and outside of all four corners. Glazing stops shall be hook-in type with EPDM glazing gaskets reinforced with non-stretchable cord.

2. Accurately fit and secure joints and corners. Make joints hairline in appearance.

3. Prepare components with internal reinforcement for door hardware.

4. Arrange fasteners and attachments to conceal from view.

2.06 Finishes

A. Factory Finishing:

1. Fluropon® (70% PVDF), AAMA 2605, Fluoropolymer Coating (Color: To be determined from manufacturer’s standard and/or custom colors).

2.07 Source Quality Control

A. Source Quality: Provide aluminum entrances specified herein from a single source.

1. Building Enclosure System: When aluminum entrances are part of a building enclosure system, including storefront framing, windows, curtain wall system and related products, provide building enclosure system products from a single source manufacturer.

B. Fabrication Tolerances: Fabricate aluminum entrances in accordance with entrance manufacturer’s prescribed tolerances.

PART 3 – EXECUTION
3.01 Examination

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer’s instructions. Verify openings are sized to receive storefront system and sill plate is level in accordance with manufacturer’s acceptable tolerances.

1. Field Measurements: Verify actual measurements/openings by field measurements before fabrication; show recorded measurements on shop drawings. Coordinate field measurements, fabrication schedule with construction progress to avoid construction delays.

3.02 Installation

A. General: Install entrance system in accordance with manufacturer’s instructions and AAMA storefront and entrance guide specifications manual.

1. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
2. Provide alignment attachments and shims to permanently fasten system to building structure.
3. Align assembly plumb and level, free of warp and twist. Maintain assembly dimensional tolerances aligning with adjacent work.
4. Set thresholds in bed of mastic and secure.
5. Adjusting: Adjust operating hardware for smooth operation.

B. Related Products Installation Requirements:

1. Sealants (Perimeter): Refer to Joint Treatment (Sealants) Section 07920.
2. Glass: Refer to Glass and Glazing Section 08800.

3.03 Cleaning and Protection
A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance. Remove construction debris from project site and legally dispose of debris.

B. Protection: Protect installed product’s finish surfaces from damage during construction. Protect aluminum entrances from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants. Remove and replace damaged aluminum entrances at no extra cost.
PART 1 - GENERAL

1.01 Summary

A. Section Includes: Kawneer Sealair® Commercial Grade and Heavy Commercial Architectural Aluminum Windows, including glass and glazing at window manufacturer’s factory, perimeter trims, sills and stools, window installation hardware and accessories, shims and anchors, and perimeter sealing of window units.

1. Types of Kawneer Sealair Aluminum Windows include:
   a. Series 8400TL, Model 8410; Thermal, 4" Deep Frame, Fixed/Offset Fixed (HC100-AW100).

1.02 System Description

A. Reference Standard Compliance: Comply with ANSI/AAMA 101 and AAMA 910 for minimum performance criteria for aluminum windows, including grade designation windows units.

1. Test Units: Conform to minimum size in accordance with ANSI/AAMA 101 and AAMA 910 for each test unit sizes and configurations. Units submitted for laboratory testing shall be manufacturer’s standard construction, glazed and assembled in accordance with manufacturer’s specifications and ANSI/AAMA 101.

B. Window Performance Requirements:
   1. Air Infiltration: The test specimen shall be tested in accordance with ASTM E283 at a minimum frame size of 72" x 72" (HC), 60" x 96" (AW). Air infiltration rate shall not exceed 0.06 cfm/ft of sash perimeter at a static air pressure differential of 6.24 psf.
   2. Water Resistance: The test specimen shall be tested in accordance with ASTM E547 and ASTM E331 at a minimum frame size of 72" x 72" (HC), 60" x 96" (AW). There shall be no leakage as defined in test method at a static air pressure differential of 12 psf.
3. Uniform Load Deflection: A minimum static air pressure difference of 100 psf shall be applied in the positive and negative direction in accordance with ASTM E330. There shall be no deflection in excess of L/175 of the span of any framing member.

4. Uniform Load Structural Test: A minimum static air pressure difference of 150 psf shall be applied in the positive and negative direction in accordance with ASTM E330. The unit shall be evaluated after each load.

5. Thermal Transmittance (U-value): When tested to AAMA Specification 503.1, the thermal transmittance (U-value) shall not be more than 0.60 BTU/hr/sf/°F.

6. Condensation Resistance (CRF): When tested to AAMA Specification 1503, the condensation resistance factor shall not be less than 58.

7. Forced Entry Resistance: Windows shall conform to ASTM F588, Performance Level 10, or AAMA 1302.5.

C. System Performance Requirements: Provide aluminum windows which have been manufactured, fabricated and installed to withstand uniform loads from 100 psf and to maintain (manufacturer’s performance criteria) without defects, damage, or failure.

1.03 Submittals

A. General: Prepare, review, approve, and submit product data, shop drawings, samples, and other submittals in accordance with “Conditions of the Contract” and Division 1 Submittals Sections. Product data, shop drawings, samples, and similar submittals are defined in “Conditions of the Contract.”

1.04 Warranty

A. Project Warranty: Refer to “Conditions of the Contract” for project warranty provisions.
B. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty.

1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by Kawneer.
2. Insulating Glass: Warranted to be free from defects (excluding breakage) for a period of five (5) years.

1.05 Quality Assurance

A. Qualifications:

1. Installer Qualifications: Installer experienced (as determined by contractor) to perform work of this section who has specialized in the installation of work similar to that required for this project and who is acceptable to product manufacturer.

2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction, approving acceptable installer and approving application method.

B. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements

PART 2 – PRODUCTS

2.01 Manufacturer’s (Acceptable Manufacturer’s/Products)


1. Spec is based on Kawneer Sealair Architectural Windows.
   a. Series: SealAir 8400TL, model 8410 fixed window.
   b. Finish color: Fluoropon (70% PVDF), AAMA2605 fluoropolymer coating. Color: To be determined.
2. Product/Systems Testing:

3. Manufacturer is to provide single source for all windows, curtain wall and storefront on project. Mixing and matching of more than one manufacturer is not allowed.

2.02 Materials

A. Aluminum (Windows and Components):
   2. Frame Depth: Not less than 4" (101.6 mm).
   3. Member Wall Thickness: Each master frame member shall have minimum wall thickness of 0.070" (1.78 mm) and shall provide structural strength to meet specified performance requirements.
   4. Dimensions: Reference to dimensions for wall thickness and other cross-sectional dimensions of window members are nominal and in compliance with ANSI H35.2-1990.

B. Mullions and Cover Plates: Shall be extruded aluminum of 6063-T5 alloy and temper of profile and dimensions indicated on drawings. Mullions shall provide structural properties to resist wind pressure required by performance criteria and standards.

C. Thermal Barrier.
   1. Frame thermal barrier shall be Kawneer Isolock® with a minimum of 5/16" (7.9) separation consisting of a two-part, chemically curing high density polyurethane which is mechanically and adhesively bonded to the aluminum.
   2. Sash thermal barrier shall be Kawneer Isolock® with a minimum of 1/4" (6.4) separation consisting of a two-part, chemically curing high density polyurethane in conditioned thermal pockets which is mechanically and adhesively bonded to the aluminum.
2.03 Accessories

A. Fasteners: Where exposed, shall be 300 Series, Stainless Steel.

B. Perimeter Anchors: Aluminum. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

2.04 Glass and Glazing

A. General: Glass thickness and type shall be in accordance with manufacturer’s recommendations for prescribed design pressure. Factory glazing shall be in accordance with manufacturer’s standard requirements.

1. Material Compatibility: Glazing materials shall be compatible with aluminum and FRP panels (where indicated).

2. Manufacturer’s Standards: Glazing method shall be a wet/dry type in accordance with manufacturer’s standards. Exterior glazing shall be pre-shimmed glazing tape. Interior glazing shall be snap-in type .062" (1.57 mm) glazing beads and a compression gasket of dense elastomer in accordance with ASTM C864.

B. Glass Materials:

1. Insulating Glass: ASTM E774, NAMI Single-Seal.
2. Safety Glazing: ANSI Z97.1 or CPSC 16 CRF 1201.
4. Glass Type: Laminated interior and exterior panes of glass.
5. Glass Thickness 1” consisting of ¼” laminated exterior ½” spacer ¼” laminated interior – Refer to Spec Section 08800 – Glass & Glazing.

PART 3 – EXECUTION

3.01 Manufacturer’s Instructions/Recommendations

A. Compliance: Comply with manufacturer’s product installation data and recommendations for installation requirements of window units, hardware, and other components in accordance with manufacturer’s warranty provisions.
3.02 Examination

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer’s instructions. Verify openings are sized to receive window units and sill plate is level in accordance with manufacturer’s acceptable tolerances.

1. Field Measurements: Verify field measurements for window installation.

3.03 Preparation

A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.

3.04 Installation

A. General: Install window units plumb, level, and true to line, without warp or rack of frames or sash with manufacturer’s prescribed tolerances. Provide support and anchor in place.

1. Dissimilar Materials: Provide separation of aluminum materials and other corrodible surfaces from sources of corrosion or electrolytic action contact points by complying with AAMA 101, Appendix, titled “Dissimilar Materials.”

2. Weathertight Construction: Install sill members and other members in a bed of sealant or with joint filler or gaskets, to provide weathertight construction. Coordinate installation with wall flashings and other components of construction.
   a. Refer to Division 7 Joint Treatments (Sealants) for installation requirements.

B. Related Products Installation Requirements:

1. Insulation (Window): Refer to Division 7 Building Insulation Section.

2. Sealants (Perimeter): Refer to Division 7 Joint Treatment (Sealants) Section.

3. Glass: Refer to Division 8 Glass and Glazing Section.
3.05 Field Quality Control

A. Field Tests: Architect shall select window units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer’s representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.

1. Testing: Testing shall be performed by a qualified independent testing agency. Refer to Division 1 Testing Section for payment of testing and testing requirements. Testing Standard per AAMA 502, including reference to ASTM E 783 for Air Infiltration Test and ASTM E 1105 Water Infiltration Test.
   a. Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.15 cfm per foot of crack length, which ever is greater.
   b. Water Penetration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 6.24 psf.

B. Manufacturer’s Field Services: Provide manufacturer’s field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer’s instructions.

3.06 Adjusting and Cleaning

A. Adjusting: Adjust operating window components to provide a tight fit at contact points and at weatherstripping for smooth operation and a weathertight closure.
B. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance. Remove construction debris from project site and legally dispose of debris.

C. Protection: Protect installed product’s finish surfaces from damage during construction. Protect aluminum windows from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants. Remove and replace damaged aluminum windows at no extra cost.

END OF SECTION 08520
PART 1 – GENERAL

1.01 Summary

A. Section Includes: Kawneer Sealair® Commercial Grade and Heavy Commercial Architectural Aluminum Windows, including glass and glazing at window manufacturer’s factory, perimeter trims, sills and stools, window installation hardware and accessories, shims and anchors, and perimeter sealing of window units.

1. Types of Kawneer Sealair Aluminum Windows include:
   a. Series 8400TL, Model 8470; Thermal, 4” Deep Master Frame, Horizontal Sliding (HC55).

1.02 System Description

A. Reference Standard Compliance: Comply with ANSI/AAMA 101 for minimum performance criteria for aluminum windows, including grade designation windows units.

1. Test Units: Conform to minimum size in accordance with ANSI/AAMA 101 for each test unit sizes and configurations. Units submitted for laboratory testing shall be manufacturer’s standard construction, glazed and assembled in accordance with manufacturer’s specifications and ANSI/AAMA 101.

B. Window Performance Requirements:

1. Air Infiltration: When closed and locked, the test specimen shall be tested in accordance with ASTM E283 at a minimum frame size of 96" x 80" (HC). Air infiltration rate shall not exceed 0.30 cfm/ft of sash perimeter at a static air pressure differential of 1.57 psf.

2. Water Resistance: When closed and locked, the test specimen shall be tested in accordance with ASTM E547 and ASTM E331 at a minimum frame size of 96" x 80" (HC). There shall be no leakage as defined in test method at a static air pressure differential of 10 psf.
3. Uniform Load Deflection: When closed and locked, a minimum static air pressure difference of 55 psf shall be applied in the positive and negative direction in accordance with ASTM E330. There shall be no deflection in excess of L/175 of the span of any framing member.

4. Uniform Load Structural Test: When closed and locked, a minimum static air pressure difference of 82.5 psf shall be applied in the positive and negative direction in accordance with ASTM E330. The unit shall be evaluated after each load.

5. Thermal Transmittance (U-value): When tested to AAMA Specification 503.1, the thermal transmittance (U-value) shall not be more than 0.74 BTU/hr/sf/˚F.

6. Condensation Resistance (CRF): When tested to AAMA Specification 1503, the condensation resistance factor shall not be less than 51.

7. Forced Entry Resistance: Windows shall conform to ASTM F588, Performance Level 10, or AAMA 1302.5.

C. System Performance Requirements: Provide aluminum windows which have been manufactured, fabricated and installed to withstand uniform loads from 65 psf and to maintain (manufacturer’s performance criteria) without defects, damage, or failure.

1.03 Submittals

A. General: Prepare, review, approve, and submit product data, shop drawings, samples, and other submittals in accordance with “Conditions of the Contract” and Division 1 Submittals Sections. Product data, shop drawings, samples, and similar submittals are defined in “Conditions of the Contract.”

1.04 Warranty

A. Project Warranty: Refer to “Conditions of the Contract” for project warranty provisions.

B. Manufacturer’s Warranty: Submit, for Owner’s acceptance, manufacturer’s standard warranty.
1. Warranty Period: Two (2) years from Date of Substantial Completion of the project provided however that the Limited Warranty shall begin in no event later than six months from date of shipment by Kawneer.

2. Insulating Glass: Warranted to be free from defects (excluding breakage) for a period of five (5) years.

1.05 Quality Assurance

A. Qualifications:

1. Installer Qualifications: Installer experienced (as determined by contractor) to perform work of this section who has specialized in the installation of work similar to that required for this project and who is acceptable to product manufacturer.

2. Manufacturer Qualifications: Manufacturer capable of providing field service representation during construction, approving acceptable installer and approving application method.

B. Pre-Installation Meetings: Conduct pre-installation meeting to verify project requirements, substrate conditions, manufacturer's installation instructions, and manufacturer's warranty requirements

PART 2 – PRODUCTS

2.01 Manufacturer’s (Acceptable Manufacturer’s/Products)


1. Spec is based on Kawneer Sealair Architectural Windows.
   b. Finish color: Fluoropon (70% PVDF), AAMA2605 fluoropolymer coating. Color: To be determined.
2. Product/Systems Testing:
3. Manufacturer is to provide single source for all windows, curtain wall and storefront on project. Mixing and matching of more than one manufacturer is not allowed.

2.02 Materials

A. Aluminum (Windows and Components):
   2. Frame Depth: Not less than 4" (101.6 mm).
   3. Member Wall Thickness: Each master frame member shall have minimum wall thickness of 0.070" (1.78 mm) and shall provide structural strength to meet specified performance requirements. Each sash member shall have a minimum wall thickness of 0.080" (2.03 mm). All vertical sash members shall be tubular construction. Meeting rail shall have a continuous interlock with double weather stripping.
   4. Dimensions: Reference to dimensions for wall thickness and other cross-sectional dimensions of window members are nominal and in compliance with ANSI H35.2-1990.

B. Mullions and Cover Plates: Shall be extruded aluminum of 6063-T5 alloy and temper of profile and dimensions indicated on drawings. Mullions shall provide structural properties to resist wind pressure required by performance criteria and standards.

C. Thermal Barrier.
   1. Frame thermal barrier shall be Kawneer Isolock® with a minimum of 5/16" (7.9) separation consisting of a two-part, chemically curing high density polyurethane which is mechanically and adhesively bonded to the aluminum.
   2. Sash thermal barrier shall be Kawneer Isolock® with a minimum of 1/4" (6.4) separation consisting of a two-part, chemically curing high density polyurethane in conditioned thermal pockets which is mechanically and adhesively bonded to the aluminum.
2.03 Accessories

A. Fasteners: Where exposed, shall be 300 Series, Stainless Steel.

B. Perimeter Anchors: Aluminum. When steel anchors are used, provide insulation between steel material and aluminum material to prevent galvanic action.

C. Hardware: Manufacturer's standard corrosion resistant hardware material compatible with aluminum.
   1. Manufacturer’s cast white bronze cam lock.

D. Insect Screens: Extruded aluminum frames, 6063-T5 alloy and temper, joined at corners; 18 x 16 mesh aluminum screen cloth; frames finished to match aluminum windows; splines shall be extruded vinyl, removable to permit rescreening.

2.04 Glass and Glazing

A. General: Glass thickness and type shall be in accordance with manufacturer’s recommendations for prescribed design pressure. Factory glazing shall be in accordance with manufacturer’s standard requirements.

   1. Material Compatibility: Glazing materials shall be compatible with aluminum and FRP panels (where indicated).

   2. Manufacturer’s Standards: Glazing method shall be a wet/dry type in accordance with manufacturer’s standards. Exterior glazing shall be pre-shimmed glazing tape. Interior glazing shall be snap-in type 0.062" (1.57 mm) glazing beads and a compression gasket of dense elastomer in accordance with ASTM C864.

B. Glass Materials:

   1. Insulating Glass: ASTM E774, NAMI Dual-Seal or Single-Seal as selected.

   2. Safety Glazing: ANSI Z97.1 or CPSC 16 CRF 1201.


5. Glass Thickness 1" consisting of ¼" laminated exterior 1/2" spacer 1/4" laminated interior. Refer to Spec Section 08800 “Glass & Glazing”.

PART 3 – EXECUTION

3.01 Manufacturer’s Instructions/Recommendations

A. Compliance: Comply with manufacturer’s product installation data and recommendations for installation requirements of window units, hardware, and other components in accordance with manufacturer’s warranty provisions.

3.02 Examination

A. Site Verification of Conditions: Verify substrate conditions (which have been previously installed under other sections) are acceptable for product installation in accordance with manufacturer’s instructions. Verify openings are sized to receive window units and sill plate is level in accordance with manufacturer’s acceptable tolerances.

1. Field Measurements: Verify field measurements for window installation.

3.03 Preparation

A. Adjacent Surfaces Protection: Protect adjacent work areas and finish surfaces from damage during product installation.

3.04 Installation

A. General: Install window units plumb, level, and true to line, without warp or rack of frames or sash with manufacturer’s prescribed tolerances. Provide support and anchor in place.

1. Dissimilar Materials: Provide separation of aluminum materials and other corrodible surfaces from sources of corrosion or electrolytic action contact points by complying with AAMA 101, Appendix, titled “Dissimilar Materials.”
2. Weathertight Construction: Install sill members and other members in a bed of sealant or with joint filler or gaskets, to provide weathertight construction. Coordinate installation with wall flashings and other components of construction.
   a. Refer to Division 7 Joint Treatments (Sealants) for installation requirements.

B. Related Products Installation Requirements:

1. Insulation (Window): Refer to Division 7 Building Insulation Section.
2. Sealants (Perimeter): Refer to Division 7 Joint Treatment (Sealants) Section.
3. Glass: Refer to Division 8 Glass and Glazing Section.

3.05 Field Quality Control

A. Field Tests: Architect shall select window units to be tested as soon as a representative portion of the project has been installed, glazed, perimeter caulked and cured. Conduct tests for air infiltration and water penetration with manufacturer’s representative present. Tests not meeting specified performance requirements and units having deficiencies shall be corrected as part of the contract amount.

1. Testing: Testing shall be performed by a qualified independent testing agency. Refer to Division 1 Testing Section for payment of testing and testing requirements. Testing Standard per AAMA 502, including reference to ASTM E 783 for Air Infiltration Test and ASTM E 1105 Water Infiltration Test.
   a. Air Infiltration Tests: Conduct tests in accordance with ASTM E 783. Allowable air infiltration shall not exceed 1.5 times the amount indicated in the performance requirements or 0.15 cfm per foot of crack length, which ever is greater.
   b. Water Penetration Tests: Conduct tests in accordance with ASTM E 1105. No uncontrolled water leakage is permitted when tested at a static test pressure of two-thirds the specified water penetration pressure but not less than 6.24 psf.
B. Manufacturer’s Field Services: Provide manufacturer’s field service consisting of product use recommendations and periodic site visit for inspection of product installation in accordance with manufacturer’s instructions.

### 3.06 Adjusting and Cleaning

A. Adjusting: Adjust operating window components to provide a tight fit at contact points and at weatherstripping for smooth operation and a weathertight closure.

B. Cleaning: Remove temporary coverings and protection of adjacent work areas. Repair or replace damaged installed products. Clean installed products in accordance with manufacturer’s instructions prior to owner’s acceptance. Remove construction debris from project site and legally dispose of debris.

C. Protection: Protect installed product’s finish surfaces from damage during construction. Protect aluminum windows from damage from grinding and polishing compounds, plaster, lime, acid, cement, or other harmful contaminants. Remove and replace damaged aluminum windows at no extra cost.

END OF SECTION 08520
SECTION 08710: FINISH HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Work included:
   1. Furnish hardware required to complete the work as shown on the drawings and as specified herein;
   2. Furnish trim attachments and fastenings, specified or otherwise required, for proper and complete installation.
   3. Furnish all items of Finish Hardware specified, scheduled, shown or required herein except those items specifically excluded from this section of the specification.
   4. These documents supersede all previous hardware specifications and shall be followed without substitution. All acceptable products are listed within these hardware specifications and all doors are specified per owners directive per meeting dated 5-3-17.

B. Related work:
   1. Division 1 – General Requirements
   2. Section 06100 – Carpentry
   3. Section 08112 – Hollow Doors and Frames
   4. Section 08210 – Wood Doors
   5. Section 08410 – FRP Doors – Aluminum Framing Systems
   6. Section 08421 – Aluminum Framed Entrances Doors
   7. Division 16 – Smoke Detection Systems
   8. Division 16 – Security Access Systems

C. Specific Omissions: Hardware for the following is specified or indicated elsewhere, unless specifically listed in the hardware sets:
   1. Cabinet Hardware.
   2. Signs, except as noted.
   3. Folding partitions, except cylinders where detailed.
   4. Sliding aluminum doors
   5. Chain link and wire mesh doors and gates
   6. Access doors and panels
   7. Overhead and Coiling doors
1.2 REFERENCES

A. National Fire Protection Associations (NFPA):
   2. NFPA 80-1999, "Installation of Fire Doors and Windows"


C. American National Standards Institute (ANSI):
   1. ANSI A 156 Standards series.

1.3 DEFINITIONS

A. "Finish Hardware": Items required for swinging, sliding and folding doors, except special types of unique and non-matching hardware specified under door and frame Sections of these Specifications.

1.4 SYSTEM DESCRIPTION

A. Design requirements:
   1. Review of hardware requirements:
      a. Thoroughly review finish hardware schedule, comparing it with the floor plan, door schedule, and door details to verify hardware requirements, quantities, door swings, finishes, and sizes.
      b. If an inconsistency or error in the proposed construction documents is suspected, the hardware supplier is to bring it immediately to the attention of the Architect. If the quantity of items is questioned, for bidding purposes, assume the higher quantity is required and price accordingly.
      c. Architect’s review of Submittals is for design concept only, and does not relieve the Contractor of the responsibility to furnish sufficient material and functions required for a complete and code-worthy installation. Determination of all quantities is the responsibility of the Contractor.
B. Performance requirements:
1. Furnish finish hardware complying with the requirements of laws, codes, ordinances and guidelines of governmental authorities having jurisdiction:

1.5 Submittals:

A. Hardware Schedule
1. Submit number of Hardware Schedules as directed in Division 1.
2. Follow guidelines established in Door & Hardware Institute Handbook (DHI) Sequence and Format for the Hardware Schedule unless noted otherwise.
3. Schedule will include the following:
   a. Door Index including opening numbers and the assigned Finish Hardware set.
   b. Preface sheet listing category only and manufacturer's names of items being furnished as follows:

<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>SPECIFIED</th>
<th>SCHEDULED</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hinges</td>
<td>Manufacturer A</td>
<td>Manufacturer B</td>
</tr>
<tr>
<td>Lock sets</td>
<td>Manufacturer X</td>
<td>Manufacturer X</td>
</tr>
<tr>
<td>Kick Plates</td>
<td>Open</td>
<td>Manufacturer Z</td>
</tr>
</tbody>
</table>

c. Hardware Locations: Refer to DHI Article 3.1 B.2 Locations.
d. Opening Description: Single or pair, number, room locations, hand, active leaf, degree of swing, size, door material, frame material, and UL listing.
e. Hardware Description: Quantity, category, product number, fasteners, and finish.
f. Headings that refer to the specified Hardware Set Numbers.
g. Scheduling Sequence shown in Hardware Sets.
h. Product data of each hardware item, and shop drawings where required, for special conditions and specialty hardware.
i. Electrified Hardware system operation description.
j. "Vertical" scheduling format only. "Horizontal" schedules will be returned "Not Approved."
k. Typed Copy.
l. Double-Spacing.
m. 8 1/2 x 11 inch sheets
n. U.S. Standard Finish symbols or BHMA Finish symbols.

B. Product Data:
   1. Submit, in booklet form Manufacturers Catalog cut sheets of scheduled hardware.
   2. Submit product data with hardware schedule.

C. Samples:
   1. Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit one sample, if required, of each type of exposed hardware unit, finished as required and tagged with full description for coordination with schedule.
   2. Samples will be returned to the supplier. Units, which are acceptable and remain undamaged through submittal, review and field comparison procedures, may, after final check of operation, be used in the work, within limitations of keying coordination requirements.

D. Submit to General Contractor/Construction Manager, the factory order acknowledgement numbers for the various hardware items to be used on the project. The factory order acknowledgement numbers shall help to facilitate and expedite any service that may be required on a particular hardware item. General Contractor/Construction Manager shall keep these order acknowledgement numbers on file in the construction trailer.
E. Electrified Hardware Drawings:
1. Submit Riser & Wire Diagram drawings RPST042517 showing relationship of all electrical hardware components to door and frame. These drawings shall be included with the submittals and are required to be modified for “as built” and included with the close out documents.
   a. Include elevation & wiring drawing showing point to point wire hook up for all components. Indicate number and gage of wires required for each item.

1.6 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the requirements and the methods needed for proper performance of the work of this Section.

B. Supplier qualifications:
   1. A recognized architectural finish hardware supplier with its’ parent company located within 100 miles of the project site.
   2. Continuously in business of finish hardware supply for not less than 5 years.

C. Provide the service of a certified AHC (Architectural Hardware Consultant) to:
   1. Be available for consultation with the Architect at no additional cost to the Owner during progress of construction, and:
      a. Inspect installation of all finish hardware items;
      b. Make all minor adjustments required; and
   2. The hardware consultant may be an employee of the supplier.

D. Installer qualifications: Employ a competent hardware installer with at least five (5) years experience installing commercial grade hardware similar to that proposed for the Work.
E. Source limitations: Obtain each type of hardware (latch and lock sets, hinges, closers, etc.) from a single manufacturer, although several may be indicated as offering products complying with requirements. Products listed within these documents shall be used without substitution.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with pertinent provisions of Section 01620.

B. Product identification:
1. Tag and mark each item separately in manufacturers unopened package, identifying it by product number and architectural opening number, as listed in the approved Finish Hardware Schedule.
2. Include instructions, templates, and fasteners needed for installation.

C. Deliver individually packaged hardware items on a vehicle operated by a direct employee of the Hardware Supplier. Contractor shall immediately, and in the presence of the Hardware Supplier, inventory the contents of the delivery.

D. Hardware supplier: Furnish finish hardware items directly to the factory or mill for factory-installation, where required.

1.8 PROJECT CONDITIONS

A. Provide a secure, well lit, dry storage area for the sole purpose of storing finish hardware. Prohibit access to all jobsite personnel, except those employed by the installing contractor.

1.9 WARRANTY

A. Manufacturer’s warranty:
1. Standard manufacturer’s warranties apply for products listed in Part 2 products.
2. Refer to Division 1 for further warranty requirements.
B. During the warranty period, replace defective work, including labor, materials and other costs incidental to the work. Replace work found to be defective as defined in the General Conditions.

C. Failures due to defective materials or workmanship to include, but not to be limited to:
   1. Failures in operation of any operating component;
   2. Defects which contribute to unsightly appearance, potential safety hazard, or potential untimely failure of the products furnished under this Section.

PART 2 - PRODUCTS

2.1 GENERAL

A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each finish hardware item is indicated in the Finish Hardware Schedule at the end of this Section.

B. Product designations:
   1. One or more manufacturers are listed for each hardware type required. Product listed is for basis of design. Only products listed in part 2 product descriptions will be allowed for substitution.

C. ANSI/BHMA designations:
   1. Used to describe hardware items, or to define quality or function. Provide products complying with these standards in addition to additional requirements of this Section.

D. Hand of door: Drawings show direction of slide, swing (“hand”) of door leaves.

E. Hardware: Use hardware manufactured to conform to published templates and, generally, prepared for machine screw installation. Do not provide hardware which has been prepared for self-tapping sheet metal screws, except as specifically indicated.
2.2 MATERIALS

A. Base metals:
   1. Manufacturer's standard metal alloy, composition, temper and hardness, but in no case of lesser (commercially-recognized) quality than that specified for applicable hardware units by applicable ANSI A156 series standard for each type hardware item and with ANSI A156.18 for finish designations indicated.
   2. Do not furnish "optional" materials for those indicated, except as otherwise specified.

B. Fasteners:
   1. Furnish Phillips flat-head screws with each hardware item, unless otherwise indicated.
   2. Exposed screws: Match finish of hardware (even where noted to be "prepared for paint").
   3. Use concealed fasteners for hardware units which are exposed when door is closed, except where no standard units of type specified are available with concealed fasteners.
   4. Do not use thru-bolts where bolt head or nut on opposite face would be exposed.
   5. Where adequate reinforcement is not feasible, thru-bolting would only be acceptable if through sleeves, or if sex-screw fasteners are used.

C. Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of finish hardware.

2.3 MANUFACTURED UNITS, GENERAL

A. Reference standards:
   1. Comply with BHMA/ANSI A156 current series for each product type.

B. Hardware finishes:
   1. Materials and Finishes Standard: Comply with ANSI A156.18 Finish designations used in schedules are listed, therein.
   2. Provide matching finishes for hardware units at each door, unless otherwise indicated.
3. Match the color and texture of hardware items to manufacturer's standard finish for the latchset, lockset, or push-pull unit.

4. Provide quality of finish, including thickness of plating or coating, composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than that specified or described by referenced standards.

C. Hardware for fire-rated openings:
1. Comply with NFPA 80
2. Tested and listed by Underwriters Laboratory (UL), or Factory Mutual (FM) for type, size and use of door, and complying with requirements of door and door frame label.
3. Provide UL or FM label on door indicating "Fire door to be equipped with fire-exit hardware".
4. Provide UL or FM label on exit device indicating "Fire Exit Hardware".

2.4 PRODUCTS

A. Hinges:
1. Continuous Hinges:
   a. Continuous shall be Pin & Barrel Stainless steel hinges with 600lb rating.
   b. ANSI/BHMA A156.26 -Grade 1.
   c. Fire-rating: "WHI-listed" or "UL-listed" as necessary
   d. Placement of fire label will be on top of the door at cont. hinge locations.
   e. Fasteners: Drill and tap each hole to receive each fastener, self-drilling fasteners not allowed.
   f. Furnish all continuous hinges with FBRG Flange Bearing option.
   g. Undersize doors according to hinge clearance requirements.
   h. Allow proper backset to accommodate door thickness.
   i. Provide EPT cutout, as specified, for power transfers.
   j. Acceptable manufacturer’s: Larsen & Shaw, IDC
2. Butt Hinges:
   a. ANSI A156.1 - for commercial quality.
   b. Provide only template-produced units.
   c. All butt hinges to be ball bearing-5 knuckle type Standard or Heavy Weight as specified.
   d. Hinges at exterior doors shall be of non-ferrous material.
   e. All hinges shall be provided Non-removable (NRP)
   f. Size and number of hinges as specified; otherwise according to hinge manufacturer’s recommendation for door size and weight.
   g. Where PT Power transfer hinges are specified provide 2,18g + 4,28G wires
   h. Acceptable products: PDQ, SDC, Bommer

B. Lock Cylinders and Keying:
1. General:
   a. Supplier shall meet with Owner and Architect to finalize keying direction and furnish a complete key schedule. The key schedule shall include keysets, marks and key schedule corresponding to each opening.

2. Cylinders:
   a. Type: Mortise or rim-type as required by function of locking device.
   b. Provide screw on cams or tail piece as required.
   c. Construct lock cylinder parts from brass/bronze, stainless steel or nickel silver.
   d. Provide solid machined cylinder rings with tension spring to resist wrenching of cylinder. Length, finish and size as required.
   e. Provide cylinder(s) and core(s) as required by function for each locking device.

3. System:
   a. Provide temporary brass construction cores for each cylinder provided.
   b. Provide restricted combined PDQ3 GM final cores.

4. Keying:
   a. Deliver keys and final cores to the hardware installation Contractor for final installation, when directed by the Owner.
b. Comply with Owner's instructions for master keying and, except as otherwise indicated, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.
c. Key material: Nickel silver
d. Key quantity:
   (1) Two (2) change keys for each lock; Two (2) core keys total.
   (2) Five (5) master keys for each master system.
   (3) Five (5) grandmaster keys for each grandmaster system

C. Flushbolts:
   1. ANSI/BHMA A156
   2. Fire-rating: "WHI-listed" and "UL-listed" as necessary
   3. Provide flushbolts with size top bolt and bottom bolt as specified.
      a. Use extended length bolts as specified or required.
      b. Use the appropriate type of bolt for wood or hollow metal as required.
   4. Use dust proof strike as specified with each set of flushbolts.
   6. Acceptable manufacturer’s: PDQ, Hiawatha, IDC

D. Locksets:
   1. Mortise Locks
      a. Comply with ANSI A156.13 - 1987, Grade 1 criteria for mortise locks
      b. Function: Functions Indicated in the hardware sets.
         i. Electrical lock requirements: Motor Driven 24VDC, Field Selectable Fail Safe / Fail Secure Trim with RX request to exit switch.
      c. Trim: Stainless Steel / BJSJ lever-type, equal to PDQ.
      d. Locks shall be built in the USA.
      e. Lockset case shall to be non-handed and have three piece latches.
      f. Acceptable products: PDQ MR series, MBS RS series, SDC 7800
2. Cylindrical Locks
   a. Comply with ANSI A156.2 -Series 4000, Grade 1 criteria for cylindrical locks
   b. Function: Mechanical and Electric functions
      Indicated in the hardware sets.
      i. Electric locks Fail Secure 24VDC + REX provided.
   c. Provide billet steel spindles on all locking functions.
   d. Locks shall be built in the USA.
   e. Trim: BSN, SFIC prepped, lever-type equal to PDQ.
   f. Acceptable products: PDQ GT, equal by MBS MB1, SDC 7200

E. Exit devices:
   1. General:
      a. Comply with ANSI A156.3, Grade 1, Types 1, 4, and 28 criteria for products supplied.
      b. At fire doors:
         (1) Provide UL or FM label on exit device indicating "Fire Exit Hardware", where appropriate.
         (2) Mount exit device using sex-bolts on labeled wood doors.
   2.a. Type: Flat, push-bar type –Thick walled aluminum body with stainless steel Touch pad.
      b. Provide functions as specified in sets.
      i. Electrical panic requirements: Motor Driven 24VDC <1 AMP inrush with SS request to exit switch.
      i. Electrical Trim requirements: Motor Driven 24VDC, Field Selectable Fail Safe / Fail Secure Trim with RX request to exit switch.
      d. Provide dead-locking latch bolts.
      e. Acceptable products: PDQ 6000, SDC 6000

F. Push Plates & Pull Plates:
   1. General:
      a. ANSI A156.6 Grade 1 criteria.
   2. Description:
      a. Pull Plate: Pull Diameter: 1", CTC: 8", Projection: 3", Plate: 4" x 16" x .050
b. Push Plate 6” x 16” x .050  
c. Base Metal: Solid Stainless Steel

3. Mounting:  
   a. Mount Pull Plate prior to Push Plate – Pull fasteners shall be concealed under Push Plate.

4. Acceptable Manufacture: Hiawatha, PDQ, IDC

G. Push / Pull bars & Grips:  
1. General:  
   a. ANSI A156.16 - 1989 Grade 1 criteria.

2. Description:  
   a. Offset pull bar 1” in diameter x 10” center to center.
   b. Straight push and/or pull bar 1” in diameter x size to door width.

3. Mounting:  
   a. Mount push-pull bars back to back with thru-bolts and A thru flow mount at free ends.
   b. Mount pull bars with thru-bolts and N thru flow mount at free ends.
   c. Mount offset pulls so as to avoid conflict with vertical rod, when used in conjunction with vertical rod exit devices.
   d. Mount back to back pulls with appropriate fasteners accounting on door thickness and type.

4. Acceptable products: Hiawatha, PDQ, FSB

H. Door closers:  
1. General:  
   a. ANSI A156.4 - 1986 Grade 1 criteria.
   b. All closers shall be the products of one manufacturer.

2. Description:  
   a. Full rack-and-pinion type
   b. Cast Iron Body.
   c. Hydraulic fluid: Non-gumming and non-freezing.
   d. Closer body: Non-handed, multi-size spring power.
   e. With three non-critical V valves and hex key adjustment to independently regulate sweep latch speed and backcheck.
   f. Provide mounting brackets necessary to clear sound seals and weatherstrip.
g. Enclose in a full, molded cover.

h. Provide drop plates or special brackets for proper mounting.

i. Pressure Relief Valves will NOT be accepted on Door Closers.

j. Provide Barrier Free power setting as required by ANSI A117.1

k. Where SCS is specified, furnish a Stainless Steel swivel snubber. Stationary snubbers, rubber grommets and studs will not be accepted.

3. Acceptable products: PDQ 7000, MBS QDC44

I. Stops:

1. General:
   a. ANSI A156.16 - 1989 Grade 1 criteria.
   b. Provide stops where scheduled, wall or floor, as opening conditions dictate, utilizing wall stops wherever possible.

2. Description:
   a. Wall stops: Cast brass, bronze or stainless steel. Concave wall stop to have stainless steel washer imbedded in rubber stop.
   b. Floor stops: Cast Stainless, brass or bronze, and plated as required.
   c. Make selection of floor stop height based upon floor conditions and door undercut.
   d. Provide magnetic hold-open wall stops where specified.

3. Acceptable products: PDQ, Hiawatha, SOSS

J. Kick plates, mop plates and armor plates:


2. Description:
   a. Minimum .050” thick
   b. Dimensions:
      (1) Width: 2” less than door width to which they are to be applied.
      (2) Kick plate height: 10”

3. Mounting:
   a. **Install kick plates and armor plates flush to bottom edge of door.**
b. Notch armor plates for lock or exit device trim or active case.

4. Acceptable manufacturers: Hiawatha, PDQ and IDC

K. Thresholds:
1. General:
   a. ANSI A156.21 - 1989, Grade 1 criteria.
   b. Comply with A.D.A. requirements, unless otherwise scheduled.
2. Description:
   a. Flat profile
   b. Installation locations are scheduled.
   c. Provide templates for thresholds to related door suppliers to coordinate proper undercut.
3. Acceptable products: Reese, IDC, KN Crowder

L. Door Seal and Inside Astragals:
1. General:
   a. ANSI A156.21 - 1989, Grade 1 criteria.
2. Description:
   a. Flat profile.
   b. Dimensions: Appropriate to door opening size.
   c. Installation locations are scheduled.
   d. Provide templates for thresholds to related door suppliers to coordinate proper undercut.
3. Mounting:
   a. Apply related hardware (closer, foot bracket, strike, etc.) on top of hardware compatible type weatherstrip.
   b. Do not notch or splice weather strip.
   c. Adjust related template hardware locations, as required.
4. Acceptable products: Reese, IDC, KN Crowder

M. Sweeps and strips:
1. General:
   a. ANSI A156.21 - 1989, Grade 1 criteria.
2. Description:
   a. Flat profile.
   b. Dimensions: Appropriate to door opening size.
   c. Installation locations are scheduled.
4. Acceptable products: Reese, IDC, KN Crowder
N. Key Control:
   a. Provide a Complete System; Including all accessories - key gathering envelopes, hook labels, permanent key tags, temporary key tags, signature receipt forms, visible index and instruction book. Provide with capacity for 150 percent of the number of locks required for the project.
   b. Provide complete cross-index system set up by hardware supplier. Place keys on markers and hooks in the cabinet as determined by the final key schedule. Provide hinged panel type cabinet for wall mounting. Provide one each wall mounted key cabinet.
   c. Provide Tel Kee RWC-Series with complete system.
   d. Supplier shall include the cost of this service in their proposal.

O. Access Control Equipment:
   1. General:
      a. All access control system components, control modules, card readers and peripherals are to be furnished by Access Control Vender.
      b. Access Control Door Hardware & Equipment specified in this section is to be furnished by hardware distributor under this section 087100 and installed by carpenter contractor under section 087100.
      c. Line voltage, circuits, cable and installation of power supplies for card readers, controllers and access control peripherals to be installed under Security Section.
   2. Access Control Components:
      a. Comply with ANSI A156.5, Grade 1 for hardware products supplied.
      b. All products to be UL or WHI listed.
      c. Type: 24 V with required amp rating for load as required.
      d. Furnish access control equipment listed in hardware sets.
      I. Electric Strikes: Furnish SDC 55 series as specified.
      II. Door Contact: SDC MC-7 Door Contacts Indicated in the hardware sets.
III. Power Transfers: SDC PTM10 Indicated in the hardware sets.

IV. Power transfer hinge: PTH 2+4 wires Indicated in the hardware sets.

c. Furnish access control equipment listed in hardware sets. Power supplies will be furnished by Security Vendor allowing for 1 amp @ 24VDC at each electrified hardware opening.

3. Acceptable products:
   a. Acceptable products SDC, PDQ

P. Swinging Power Operated Doors:
   1. General:
      a. All automatic doors shall comply with ANSI 156.19 and be UL listed.
      a. All automatic doors shall be low energy type.
      b. Furnish all necessary peripherals for each opening for the application as scheduled.
      c. Provide Fire Alarm contacts at all rated openings.
      d. Automatic door equipment must be installed by an AAADM installer. AAADM certification must be supplied to owner upon completion.
      e. Furnish actuators as scheduled.
      f. Acceptable products: Record 8100 LE, SDC AUTO

Q. Detention Door Hardware:
   1. All Detention Doors, Frames and Hardware provided by DEC - Detention Equipment Contractor.

R. Miscellaneous Hardware Equipment and Material:
   1. General:
      a. Provide items and types as specified.

2.5 OTHER MATERIALS

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.
2.6 HARDWARE FINISHES

A. General:
1. Provide matching finishes for hardware units at each door or opening, to the greatest extent possible and except as otherwise indicated.
2. Reduce differences in color and textures as much as commercially possible where the base metal or metal forming process is different for individual units of hardware exposed at the same door or opening.
3. In general, match items to the manufacturer's standard finish for the latch and lock set (or push/pull units if no latch/lock sets) for color and texture.
4. Provide finishes matching those established by BHMA or, if none established, match the Architect's sample.
5. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness and other qualities complying with manufacturer's standards, but in no case less than that specified for the applicable units of hardware by referenced standards.
6. Finish designations used in schedules and elsewhere listed in ANSI A156.18 "Materials and Finishes Standard", including coordination with the traditional U.S. finishes shown by certain manufacturers for their products.

B. Provide the following hardware finishes, unless otherwise scheduled:
   Dull Chrome, Stainless Steel, and Aluminum color pallet.

C. Base material: Manufacturer’s standard high-carbon steel, brass, or bronze.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Examine the areas and conditions under which work of this Section will be performed. Correct conditions detrimental to timely and proper completion of the Work. Do not proceed until unsatisfactory conditions are corrected.
3.2 COORDINATION

A. Coordinate as required with other trades to assure proper and adequate provision in the work of those trades for interface with the work of this Section.

3.3 INSTALLATION

A. General:
1. Install each item in its proper location firmly anchored into position, level and plumb, and in accordance with the manufacturer's recommendations.
2. Handing, hardware heights, locations, and degree of opening swing are indicated in the Drawings and Finish Hardware Schedule.
3. Mount finish hardware units:
   a. At recommended heights and locations as shown in approved finish hardware schedule, complying with requirements of the A.D.A., and pertinent provisions of the Building Code.
   b. To function at proper degree of opening of doors as indicated on approved finish hardware schedule.
   c. By manufacturer's template.
   d. Prior to final finishing of the door. Remove hardware to allow finishing of door, and permanently reinstall hardware upon completion of finishing operation.
3. Reinforce, where necessary, the substrate to assure proper attachment.
4. Drill and countersink units which are not factory-prepared for anchorage fasteners.
5. Space fasteners and anchors in accordance with industry standards.

B. Installing closers:

1. Mount closers per manufacturer's template, and secure the Architect's approval of the closer installation.
2. The Contractor will be required to REPLACE doors onto which closers are improperly mounted at no additional cost to the Owner. Repair or patching of such doors will not be acceptable.
C. Installing Stops: Install all wall stops into reinforced wall or stud. Projection type wall stops (115) should be mounted 80” from finish floor, with sloped portion of the stop facing up / flat side down. Install floor stops out of the way foot traffic at a height high enough to accommodate any ramp or uneven floor condition.

D. Installing thresholds at exterior doors: Set in full bed of butyl-rubber, or polyisobutylene mastic sealant.

E. Installing weatherstrip: Install weatherstrip prior to installing closers, OH Stops or panic hardware. Template closers and panic devices from weatherstrip and install all closer / OH Stop shoe brackets and panic device strikes onto the weatherstrip without notching or cutting the weatherstrip.

F. Installing Sweeps: Install all sweeps on exterior side of opening.

3.4 FIELD QUALITY CONTROL

A. Inspection of final hardware installation: The Contractor, hardware suppliers, and Architectural Hardware Consultant (AHC) shall thoroughly check the quality of the installation and the functionality of each unit of finish hardware at all openings in the Work. The Hardware Supplier shall forward a detailed written report of all operational or installation deficiencies to the Architect and Contractor.

3.5 CLEANING AND ADJUSTING

A. Check and adjust each item of hardware and each door upon completion of final installation. Verify proper function, and replace units which cannot be made to operate freely and smoothly, as intended for the application.

B. Clean adjacent surfaces soiled by hardware installation.
3.6 FINISH HARDWARE SCHEDULE

Hardware Set 1 -Electric Panic Devices w/ Pull Trim [Lock / Unlock] + Auto Operator

2 ea.  Continuous Hinge LS300  32D
1 ea   Panic Device 6212R (01) (CD)  32D
1 ea   Panic Device 6212R (03) (CD)  32D
1 ea.  Keyed Mullion 9200M-11(paint to match surrounding) USP 32D
1 ea.  Rim Cylinder I5308 x I5207-1 PDQ3 (03)  26D
2 ea.  Mortise Cylinder I5308 x I5207-1 PDQ3 (CD)  26D
1 ea.  Rim Cylinder I5308 x I5207-1 PDQ3 (KM)  26D
2 ea.  Pull 658A x A Mount  32D
1 ea   Closer 7101 BC SCS stop (push side mount)  AL
1 ea.  Power Operator 8100LE ANSI 156.19  AL
1 ea.  Overhead Stop OH4103S (power operator location)  32D
1 ea.  Exterior Actuator AA-3WR  32D
1 ea.  Vestibule Actuator AA-3AL x AA-3AR  32D
1 ea.  Threshold S205 (notch & cope as required)  AL
2 sets  Sweeps and Weatherstrip by door and frame supplier AL
1 ea.  Access Control Module, power supply and reader, by Security Vender

1 set  Riser & Wire Drawings RPIST042517  ----

Note: Coordinate operators for vestibule function sequence.

Hardware Set 2 -Push / Pull Trim [Always Unlocked] + Auto Operator

2 ea  Continuous Hinge LS300  32D
2 sets  Push / Pull 658AX1081LBP x A Mount  32D
1 ea   Closer 7101 BC SCS stop (push side mount)  AL
1 ea.  Power Operator 8100LE ANSI 156.19  AL
1 ea.  Overhead Stop OH4103S (power operator location)  32D

Note: Coordinate operators for vestibule function sequence.
Hardware Set 3 -Electric Panic Devices w/ Exit Only [Always Locked] + Auto Operator

2 ea. Continuous Hinge LS300 32D
1 ea Panic Device 6212R (01) (CD) 32D
1 ea Electric Panic Device MLR 6202R (01)
   (power operator location) 32D
1 ea. Power Supply 602RF ----
1 ea. Keyed Mullion 9200M-11 (paint to match surrounding) USP
1 ea. Mortise Cylinder I5308 x I5207-1 PDQ3 (CD) 26D
1 ea. Rim Cylinder I5308 x I5207-1 PDQ3 (KM) 26D
1 ea. Closer 7101 BC SCS stop (push side mount) AL
1 ea. Power Operator 8100LE ANSI 156.19 AL
1 ea. Overhead Stop OH4103S (power operator location) 32D
1 ea. Vestibule Actuator AA-3AL x AA-3AR 32D
1 ea. Threshold S205 (notch & cope as required) AL
2 sets Sweeps and Weatherstrip by door and frame supplier AL
Note: Coordinate operators for vestibule function sequence.

Hardware Set 4 -Push / Pull Trim [Always Unlocked] + Auto Operator

2 ea Continuous Hinge LS300 32D
2 sets Push / Pull 658AX1081LBP x A Mount 32D
1 ea. Closer 7101 BC SCS stop (push side mount) AL
1 ea. Power Operator 8100LE ANSI 156.19 AL
1 ea. Overhead Stop OH4103S (power operator location) 32D
1 ea. Interior Actuator AA-3W 32D
Note: Coordinate operators for vestibule function sequence.

Hardware Set 5 -Storeroom lock [Always Locked]

3 ea. Butt Hinges 35STBB 4545 NRP 26D
1 ea. Storeroom Lockset GT 115 BSN IC SF7 -PDQ3 26D
1 ea Wall / Floor Stop 102 / 220 -type as required 26D

Hardware Set 6 -Push / Pull Trim [Always Unlocked] + Closer

6 ea. Butt Hinges 35STBB 4545 NRP 26D
2 sets Push / Pull 658AX1081LBP x A Mount 32D
2 ea. Door Closer 7101 BC PA Regular Arm (pull side mount) AL
2 ea Wall / Floor Stop 102 / 220 -type as required 26D
2 ea. Kickplate 98 10 x 2” LDW 32D
Hardware Set 7 - Electric lock [Access Control] + Closer

2 ea. Butt Hinges 35STBB 4545 NRP 26D
1 ea. PT Hinge PTH-2+4 26D
1 ea. Electric Lockset GT 199 FSC REX 24V BSN IC SF7–PDQ3 26D
1 ea. Mortise Cylinder I5307 x I5207-1 PDQ3 (199A) 26D
1 ea. Closer 7101 BC Regular Arm (pull side mount) AL
1 ea. Wall / Floor Stop 102 / 220 -type as required 26D
1 ea. Kickplate 98 10 x 2” LDW 32D
1 ea. Access Control Module and reader, by Security Vender ----
1 set Riser & Wire Drawings RPIST042517 ----
1 ea Power Supply 602RF ----
Note: Access control module, reader and peripherals coordinated by Security Vender.

Hardware Set 8 - Office lock [Lock / Unlock]

3 ea. Butt Hinges 35STBB 4545 NRP 26D
1 ea. Office lock GT 116 BSN IC SF7 –PDQ3 26D
1 ea. Wall / Floor Stop 102 / 220 -type as required 26D

Hardware Set 9 - Privacy Set [Lock / Unlock] + Closer

3 ea. Butt Hinges 35STBB 4545 NRP 26D
1 ea. Privacy Set GT 176 BSN 26D
1 ea. Closer 7101 BC EDA (push side mount) AL
1 ea. Wall / Floor Stop 102 / 220 -type as required 26D
1 ea. Kickplate 98 10 x 2” LDW 32D

Hardware Set 10 - Passage Set [Always Unlocked]

3 ea. Butt Hinges 35STBB 4545 NRP 26D
1 ea. Passage Set GT 126 BSN 26D
1 ea. Wall / Floor Stop 102 / 220 -type as required 26D

Hardware Set 11 - Classroom lock [Lock / Unlock]

3 ea. Butt Hinges 35STBB 4545 NRP 26D
1 ea. Classroom Lockset GT 148 BSN IC SF7 –PDQ3 26D
1 ea. Wall Stop 102 26D
Hardware Set 12 - Push / Pull [Always Unlocked] + Closer

- 3 ea. Butt Hinges 35STBB 4545 NRP 26D
- 1 ea. Pull Plate 862-3D (mount prior to push plate) 32D
- 1 ea. Push Plate 963 (Mount over Pull fasteners) 32D
- 1 ea. Closer 7101 BC PA Regular Arm (pull side mount) AL
- 1 ea. Wall / Floor Stop 102 / 220 -type as required 26D
- 1 ea. Kickplate 98 10 x 2” LDW 32D

Hardware Set 13 - Privacy Set [Lock / Unlock] + Closer

- 3 ea. Butt Hinges 35STBB 4545 NRP 26D
- 1 ea. Privacy Set GT 176 BSN 26D
- 1 ea. Closer 7101 BC PA Regular Arm (pull side mount) AL
- 1 ea. Wall Stop 102 26D
- 1 ea. Kickplate 98 10 x 2” LDW 32D

Hardware Set 14 - SVR Panics + Classroom Trim [Lock / Unlock] + Closer

- 6 ea. Butt Hinge 35STHB 4545 26D
- 2 ea. Panic Device 6201V(08)(CD)x 6EW08BSN Classroom Trim 32D
- 1 ea. Mortise Cylinder I5307 x I5207-1 PDQ3 (08) 26D
- 1 ea. Mortise Cylinder I5307 x I5207-1 PDQ3 (CD) 26D
- 2 ea. Closer 7101 BC EDA (push side mount) AL
- 2 ea. Wall Stop 115 26D
- 2 ea. Kickplate 98 10” x 2” LDW 32D

Hardware Set 15 - Electric Panic Device w/ Pull Trim [Access Control] + Closers

- 5 ea. Butt Hinge 35STHB 4545 NRP 26D
- 1 ea. PT Hinge PTH-2+4 HW 26D
- 1 ea. Panic Device 6200R (01) less dogging / exit only 32D
- 1 ea. Electric Panic Device MLR SS 6200R (03) (active door) 32D
- 1 ea. Keyed Mullion 9200M-11 (paint to match surrounding) USP
- 1 ea. Rim Cylinder I5308 x I5207-1 PDQ3 (03) 26D
- 1 ea. Rim Cylinder I5308 x I5207-1 PDQ3 (KM) 26D
- 1 ea. Pull 658A x A Mount (active door) 32D
- 2 ea. Closer 7101 BC EDA (push side mount) AL
- 2 ea. Wall Stop 115 26D
- 2 ea. Kickplate 98 10 x 2” LDW 32D
- 1 ea. Access Control Module and reader, by Sec. Vender ----
- 1 set Riser & Wire Drawings RPIST042517 ----
- 1 ea Power Supply 602RF ----

Note: Access control module, reader and peripherals coordinated by Security Vender.
Hardware Set 16 - Rated Panic Device w/ Classroom Trim [Lock / Unlock] + Closer Stop

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butt Hinge 35STHB 4545 NRP</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Panic Device 6200RF x 6EW08BSN Classroom Trim</td>
<td>1</td>
<td>32D</td>
</tr>
<tr>
<td>Mortise Cylinder I5307 x I5207-1 PDQ3 (08)</td>
<td>1</td>
<td>26D</td>
</tr>
<tr>
<td>Door Closer 7101 BC EDA (push side mount)</td>
<td>1</td>
<td>AL</td>
</tr>
<tr>
<td>Wall Stop 102</td>
<td>1</td>
<td>26D</td>
</tr>
<tr>
<td>Kickplate 98 10 x 2” LDW</td>
<td>1</td>
<td>32D</td>
</tr>
</tbody>
</table>

Hardware Set 17 - Electric lock [Access Control] + Closer

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butt Hinges 35STBB 4545 NRP</td>
<td>2</td>
<td>26D</td>
</tr>
<tr>
<td>PT Hinge PTH-2+4</td>
<td>1</td>
<td>26D</td>
</tr>
<tr>
<td>Electric Lockset GT 199 FSC REX 24V BSN IC SF7-PDQ3</td>
<td>1</td>
<td>26D</td>
</tr>
<tr>
<td>Mortise Cylinder I5307 x I5207-1 PDQ3 (199A)</td>
<td>1</td>
<td>26D</td>
</tr>
<tr>
<td>Closer 7101 BC EDA (push side mount)</td>
<td>1</td>
<td>AL</td>
</tr>
<tr>
<td>Wall / Floor Stop 102 / 220 -type as required</td>
<td>1</td>
<td>26D</td>
</tr>
<tr>
<td>Kickplate 98 10 x 2” LDW</td>
<td>1</td>
<td>32D</td>
</tr>
<tr>
<td>Access Control Module and reader, by Sec. Vender</td>
<td>1 set</td>
<td>----</td>
</tr>
<tr>
<td>Riser &amp; Wire Drawings RPIST042517</td>
<td>1 set</td>
<td>----</td>
</tr>
<tr>
<td>Power Supply 602RF</td>
<td>1</td>
<td>----</td>
</tr>
</tbody>
</table>

Note: Access control module, reader and peripherals coordinated by Security Vender.

Hardware Set 18 - Deadbolt Lock [Always Locked] + Closer Stop

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Hinge LS3000</td>
<td>1</td>
<td>32D</td>
</tr>
<tr>
<td>Deadbolt Lockset MR 141 BJSJ</td>
<td>1</td>
<td>32D</td>
</tr>
<tr>
<td>Mortise Cylinder I5307 x I5207-1 PDQ3 (141)</td>
<td>1</td>
<td>26D</td>
</tr>
<tr>
<td>Door Closer 7101 BC SCS stop (push side mount)</td>
<td>1</td>
<td>AL</td>
</tr>
<tr>
<td>Threshold S205 (notch &amp; cope as required)</td>
<td>1 set</td>
<td>AL</td>
</tr>
<tr>
<td>Sweep and Weatherstrip by door and frame supplier</td>
<td>1 set</td>
<td>AL</td>
</tr>
</tbody>
</table>

Hardware Set 19 - Privacy Set [Lock / Unlock]

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butt Hinges 35STBB 4545 NRP</td>
<td>3</td>
<td>26D</td>
</tr>
<tr>
<td>Privacy Set GT 176 BSN</td>
<td>1</td>
<td>26D</td>
</tr>
<tr>
<td>Wall Stop 102</td>
<td>1</td>
<td>26D</td>
</tr>
</tbody>
</table>
### Hardware Set 20 - Rim Panic Device with Passage Trim [Always Unlocked] + Closer

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butt Hinge 35STHB 4545 NRP</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Panic Device 6200R Less dogging x 6EW14BSN Passage Trim</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Door Closer 7101 BC EDA (push side mount)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Wall Stop 102</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Kickplate 98 10 x 2” LDW</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

### Hardware Set 21 - Storeroom Lock (locked both sides) x Electric Strike [Access Control / Readers both sides] + Closer

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butt Hinge 35STBB 4545 NRP</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Double Storeroom Lockset GT 128 BSN IC SF7-(2) PDQ3</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Electric Strike SDC 55-A FSC 24V</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Door Closer 7101 BC EDA (push side mount)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Wall Stop 102</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Kickplate 98 10 x 2” LDW</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Access Control Module and readers, by Sec. Vender</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Riser &amp; Wire Drawings RPIST042517</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Power Supply 602RF</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Note: Access control module, readers and peripherals coordinated by Security Vender.

### Hardware Set 22 - Passage Set [Always Unlocked] + Closer

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Butt Hinges 35STBB 4545 NRP</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>Passage Set GT 126 BSN</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Door Closer 7101 BC EDA (push side mount)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Wall Stop 102</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Kickplate 98 10 x 2” LDW</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

### Hardware Set 23 - Electric Lock [Access Control] + Closer

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Quantity</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continuous Hinge LS300 EPT SDC</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Power Transfer PTM-10</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Electric Lock MR 199A FSC REA 24V BJSJ</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Mortise Cylinder I5307 x I5207-1 PDQ3 (199A)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Door Closer 7101 BC EDA (push side mount)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Wall Stop 115</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Threshold S205 (notch &amp; cope as required)</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Sweep and Weatherstrip by door and frame supplier</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Access Control Module and readers, by Security Vender</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Riser &amp; Wire Drawings RPIST042517</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Power Supply 602RF</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

Note: Access control module, reader and peripherals coordinated by Security Vender.
Hardware Set 24 - Detention Door Hardware System; door, frame and hardware;
Furnished by DEC Detention Equipment Contractor.

Hardware Set 25 - Exit Only Alarmed Panic Device [Always Locked] + Closer Stop

1 ea. Continuous Hinge LS300 32D
1 ea Exit Only Alarmed Panic Device AL 6200R (01) 32D
1 ea. Mortise Cylinder I5307 x I5207-1 PDQ3 (AL) 26D
1 ea. Door Closer 7101 BC SCS stop (push side mount) AL
1 ea. Threshold S205 (notch & cope as required) AL
1 set Sweep and Weatherstrip by door and frame supplier AL

Hardware Set 26 - Push / Pull Trim [Always Unlocked] + Closer Stops

6 ea. Butt Hinges 35STBB 4545 NRP 26D
2 sets Push / Pull 658AX1081LBP x A Mount 32D
2 ea. Door Closer 7101 BC SCS stop (push side mount) AL
2 ea. Kickplate 98 10 x 2” LDW 32D

Hardware Set 27 - Push / Pull Trim [Always Unlocked] + Closer

3 ea. Butt Hinges 35STBB 4545 NRP 26D
1 sets Push / Pull 658AX1081LBP x A Mount 32D
1 ea. Wall Stop 102 26D
1 ea. Kickplate 98 10 x 2” LDW 32D

Hardware Set 28 - Push / Pull Trim [Always Unlocked] + Closer

1 ea Continuous Hinge LS300 32D
1 set Push / Pull 658AX1081LBP x A Mount 32D
1 ea Closer 7101 BC EDA (push side mount) AL
1 ea. Wall Stop 115 26D
1 ea. Kickplate 98 10 x 2” LDW 32D

Hardware Set 29 - Push / Pull Trim [Always Unlocked] + Closer

1 ea Continuous Hinge LS300 32D
1 set Push / Pull 658AX1081LBP x A Mount 32D
1 ea Closer 7101 BC EDA (push side mount) AL
1 ea. Wall Stop 115 26D
Hardware Set 30 - Electric Panic Device w/ Pull Trim [Access Control] + Closer Stop

1 ea. Continuous Hinge LS3000 EPT SDC 32D
1 ea. Power Transfer PTM-10 AL
1 ea. Electric Latch Retraction Panic Device MLR SS 6202R (03) 32D
1 ea. Rim Cylinder I5308 x I5207-1 PDQ3 (03) 26D
1 ea. Pull 658A x A Mount 32D
1 ea. Door Closer 7101 BC SCS stop (push side mount) AL
1 ea. Threshold S205 (notch & cope as required) AL
1 set Sweeps and Weatherstrip by door and frame supplier AL
1 ea. Access Control Module, power supply and reader, by Security Vendor
1 set Riser & Wire Drawings RPIST042517 ----
1 ea Door Contact MC-7 ----
1 ea Power Supply 602RF ----
Note: Access control module, reader and peripherals coordinated by Security Vendor.

Hardware Set 31 - Passage Set [Always Unlocked] + Closer Stop

3 ea. Butt Hinges 35STBB 4545 NRP 26D
1 ea. Passage Set GT 126 BSN 26D
1 ea. Door Closer 7101 BC BSN 26D
1 ea. Kickplate 98 10 x 2” LDW 32D

Hardware Set 32 - Double Sided Lock [Locked / Unlocked both sides] + Closer Stop

1 ea. Continuous Hinge LS3000 32D
1 ea. Double Storeroom Lockset GT 137 BSN IC SF7-(2) PDQ3 26D
1 ea. Closer 7101 BC BSN SCS stop (push side mount) AL
1 ea. Floor Stop 220 26D
1 ea. Threshold S205 (notch & cope as required) AL
1 set Sweeps and Weatherstrip by door and frame supplier AL
41-A DISTRICT COURT
SHELBY TOWNSHIP
BID ISSUE 0132-1001 JULY 10, 2017

Hardware Set 33 - Rim Panic + Storeroom Trim [Always Locked] + Closer

3 ea. Butt Hinge 35STBB 4545 NRP  26D
1 ea. Panic Device 6200R Less Dogging x 6EW09BSN
   Storeroom Trim  32D
1 ea. Mortise Cylinder I5307 x I5207-1 PDQ3 (09)  26D
1 ea. Closer 7101 BC EDA (push side mount)  AL
1 ea. Kickplate 98 10” x 2” LDW  32D
1 ea. Wall Stop 115  26D

Hardware Set 34 - Push/Pull + Closer

3 ea. Butt Hinge 35STBB 4545 NRP  26D
1 ea. Pull Plate 862-3D (mount prior to push plate)  32D
1 ea. Push Plate 963 (mount over pull fasteners)  32D
1 ea. Closer 7101 BC EDA (push side mount)  AL
1 ea. Wall/Floor Stop 102/220 - type as required  26D
1 ea. Kickplate 98 10” x 2” LDW  32D

END OF SECTION 08710
PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. The extent of glass and glazing work is shown on the drawings.

B. The required applications of glass and glazing include (but are not necessarily limited to) the following:

1. Aluminum Windows
2. Aluminum Framed Storefronts & Entrance Doors
3. FRP Doors - Aluminum Framing Systems
4. Glazing Interior Doors (non-rated)
5. Glazing Interior Borrowed Lites (non-rated)

C. Related Work Specified Elsewhere:

1. Security Glass: Section 08805
2. Fire Rated Glass: Section 08810

1.03 QUALITY ASSURANCE:


B. Heat-Treated Glass Standard: Comply with the following as applicable.


C. Insulating Glass Seal Standard: Comply with proposed standard ASTM E6-P-3, Test Methods P1 and P2.

D. Manufacturers: Provide each type of glass and primary sealant/gasket from a single manufacturer with not less than five (5) years of successful experience in the production of materials similar to those required.
E. Installer (Glazier): Firm with not less than five (5) years of successful experience in glazing work similar to required work.

1.04 SUBMITTALS:

A. Product Data:

1. Submit manufacturer's product specifications, including documentation to compliance with requirements and instructions for handling, storing, installing, cleaning and protecting each type of glass and glazing materials.

B. Samples:

1. Submit two (2) samples of each type of glass and glazing material required, except for single-pane clear glass (including annealed and tempered). Submit 12" square glass samples and 12" lengths of installed (mocked-up) glazing materials.

   a. Submit insulating glass samples with completed edge-seal construction, but hermetic seal need not be maintained.

C. Warranties:

1. Warranty on Insulating Glass Units: Provide written warranty signed by fabricator (manufacturer) and countersigned by Contractor/Installer agreeing to within ten (10) years from date of substantial completion replace glass units with defective hermetic seal of air spaces (but not including that due to glass breakage); defined to include intrusion of dirt or moisture, internal condensation or fogging at temperature above -20 degrees F., deterioration of protected internal glass coatings resulting from seal failure, and other visual evidence of seal failure or performance; provide the manufacturer's printed and submitted instructions for handling, protecting, and maintaining units that have been adhered to during the warranty period.

2. Warranty on Laminated Glass: Provide written warranty signed by laminator (manufacturer) and countersigned by Contractor/Installer agreeing to within five (5) years after date of acceptance, replace glass units with defective lamination, defined to include evidence of delamination, changes in required strengths, transmittances, color, transparency, and other required performance.
1.05 PRODUCT HANDLING:

A. Comply with manufacturer's instructions for shipping, handling, storing, and protecting glass and glazing materials. Exercise exceptional care to prevent edge damage to glass, and damage/deterioration to coatings on glass.

1.06 JOB CONDITIONS:

A. Pre-Installation Meeting: Comply with General Requirements for pre-installation meeting of Glazier and other trades affected by glass installation.

B. Weather: Do not proceed with glazing under adverse weather conditions. Install liquid sealants when temperatures are within lower or middle third of temperature range recommended by manufacturer.

PART 2 - PRODUCTS

2.01 GLASS

A. Non-processed Glass:

1. Clear Float/Plate: Type I, Class 1, Quality q3.
2. Laminating Film: Except as otherwise indicated, provide clear transparent permanent film of polyvinyl butyryl (PVB), not less than 30 mils thick, as adhesive plastic interlayer for laminating sheets of glass of a composition which has successfully withstood a minimum of 20 years exposure to sunlight and severe weather/temperature changes.

B. Processed Glass:

1. Tempered Glass: Heat treat to strengthen glass in bending to not less than 4.5 times annealed strength.

2. Tong Marks: Wherever the glazing system sown for the installation of tempered glass will not conceal the tong marks inherent from normal tempering processes, provide tempered glass produced by special process which eliminates tong marks.
C. Fabricated Products:

1. Laminated Glass:
   a. Laminate units at the factory using manufacturer's standard pressure-plus-heat process to produce units of the required sizes, thicknesses, and component make-up to comply with the details and performance requirements shown and specified herein. Exercise extreme precautions and plant control in the laminating process to exclude dirt and other foreign matter from the lamination, and to eliminate voids and achieve complete lamination at each glass surface.
   b. Fabricate units to proper size and shape at the factory so that no cutting, seaming, or nipping will be required for installation at the project site.
   c. Provide the following type:
      (1) 1/4" Clear of Solarbronze (clear) by PPG or equal consisting of:
          Exterior Glass: 1/8" tempered glass
          Laminating Film: 30 mils thick
          Interior Glass: 1/8" tempered glass
          A. "Solarbronze Glass"
             Visible light transmission 47%
             U value winter 0.47
             U value summer 0.50
             SHGC 0.51
             Shading Coefficient 0.59
             Outdoor visible light reflectance 8%
             Outdoor appearance: Light bronze color, low reflective glass product
      (2) ¼" clear:
          Exterior Glass: 1/8" clear plate tempered glass
          Laminating Film: 30 mils thick
          Interior Glass: 1/8" clear plate temp. glass

2. Insulating Glass:
   a. Fabricate and label units to match units which have been tested and certified by the Insulating Glass Certification Council in accordance with proposed standard ASTM E6-P3, Test Methods, P1 and P2 (as sponsored by the Sealed Insulating Glass Manufacturers Association); and passed tests for glass seal classification "A".
b. Fabricate units with a permanent, hermetically sealed dry air or glass filled space of the width indicated between sheets of glass as indicated. Provide an edge seal consisting of twin primary sealant beads of silicone positioned and retained by a tubular aluminum or galvanized steel spacer-bar frame with soldered/welded sealed corners, and filled with desiccant with breather ports into sealed space; with secondary edge sealant completely encapsulating outer face of spacer bar and sealed to the opposing sheets of glass. Provide silicone elastomeric sealant as secondary edge seal.

   (1) Extend secondary sealant to provide minimum of 1/16" thick elastomeric coating on edges of glass sheets in each insulating glass unit (to form a protective edge cushion).

   (2) Width: Except as otherwise indicated, fabricate units with 1/2" wide air spaces.

   (3) Fill air spaces by fabricator's standard process, using either gas or dry air with a maximum dew point of -20 degrees F. Exercise extreme care to exclude dirt and other foreign substances.

c. Label each unit to show compliance with required standards and regulations, and to list generically each component including elements of edge seal. Indicate which face of unit is for exposed to exterior of weather. Provide removable label except where regulations require a permanent label.

   (1) Label interior-exposed edge of spacer bar with fabricator's name and date of completing hermetic seal.

d. Provide the following types:

**IG-1:**

Exterior Glass: ¼" laminated ("Solarbronze" Clear by PPG) with Solarban 67 low E coating on #2 surface (of 160).

Air Apace: ½"

Interior Glass: ¼" laminated clear plate
D. Design Thickness:
   1. Verify all glass thicknesses will comply with performance requirements.

E. Manufacturer of Glass: One of the following:
   1. Old Castle Building Envelope
   2. Saint-Gobain North America
   3. Pilkington North America, Inc.
   4. PPG Industries, Inc.
   5. Guardian Industries, North America
   6. Viracon, Inc., Owatonna, MN

F. Edges:
   1. Polish edges wherever exposed to view.

G. Coatings:
   1. Provide low emissivity (low-E) pyrolytic coating Solarban 67 Vitro architectural glass (formerly PPG Glass) (on #2 surface of insulated units).

2.02 GLAZING SEALANTS, COMPOUNDS AND GASKETS:

A. Colors: Provide black or other natural color where no other color is available. Where material is not exposed to view, provide manufacturer's standard color which has the best overall performance characteristics for application shown.

B. Hardnesses shown and specified are intended to indicate general range necessary for overall performance. Consult manufacturer's technical representative to determine actual hardness recommended for conditions of installation and use. Architect will furnish information concerning anticipated glass movement related to actual glazing channel width and installation temperature upon request. Except as otherwise indicated or recommended, provide glazing materials within the following ranges of hardness (Shore A, fully cured, at 75 degrees F.):
1. 15 to 35 for elastomeric compounds and tapes used with rigid stops and frames for large glass sizes (in excess of 100 united inches). Provide material sufficiently hard to withstand exposure (if any) to abrasion and vandalism.

2. 25 to 50 for rubber-like curing compounds used with rigid stops and frames for medium and small glass sizes (less than 100 united inches). Provide materials sufficiently hard to withstand impact where used on moving sash and doors.

3. 35 to 60 for molded gaskets used with rigid stops and frames, depending upon strength needed for applications or insertion of units and open profile of gasket.

4. 70 to 80 for structural gaskets (not supported by stops).

5. Non-Elastomeric Compounds: (Shore A not applicable) 2 to 12 mm penetration for 5.0 seconds of penetrometer needle on nominally cured compound (ASTM D 2451).

C. Compatibility: Before purchase of specified glazing materials, investigate compatibility with channel surfaces, joint fillers, and other materials in glazing channel. Provide only materials (manufacturer's recommended variation of specified materials) which are known to be fully compatible with actual installation condition, as shown by manufacturer's published data or certification.

D. Provide size and shape of gaskets and preformed glazing units as shown, or if not shown, as recommended by manufacturer, either in published data or upon consultation with technical representative.

E. Nonporous Bond Silicone Rubber Glazing Sealant"

1. One-part acid-type silicone rubber elastomeric sealant, complying with FS TT-S-001543, Class A, non-sag, recommended by manufacturer for non-porous exterior joint surfaces and for glazing.
2. Products/Manufacturers: Provide one of the following:

   a. 781 Building Sealant; Dow Corning Corporation
   b. Silicone Construction 1200 Sealant; General Electric Company
   c. Rhodorsil Sealant 3B; Rhodia Inc. Chemical Division

F. Preformed Butyl Rubber Glazing Sealant:

   1. Preformed ribbon or tape (coiled with release paper) of polymerized butyl (or mixture of butyl and polyisobutylene) with inert fillers (pigments), solvent-based with minimum 95% solids, non-sag consistency, tack-free time of 24 hours or less, paintable, non-staining, pre-shimming to prevent stretch (as required by Glazier to facilitate proper application and glass installation).

   2. Product/Manufacturer:
      a. Polyshim Tape: Tremco, Inc.

   3. Use for exterior glazing of all glass in aluminum entrance framing unless noted otherwise and in all interior glazing.

2.03 MISCELLANEOUS GLAZING MATERIALS:

   A. Channel Cleaner: Use type compound recommended by sealant manufacturer for channel surfaces to be cleaned.

   B. Channel Primer/Sealer: Provide type of primer or sealer recommended by sealant manufacturer for application of sealant to channel surfaces.

   C. Setting Blocks: Neoprene or other resilient blocks of 70 to 90 Shore A durometer hardness, tested for compatibility with specified glazing sealants.

   D. Spacers: Neoprene or other resilient blocks of 40 to 50 Shore A durometer hardness, adhesively backed on one face only, tested for compatibility with specified glazing sealants.

   E. Compressible Filler Rod: Closed-cell or waterproof-jacketed foam of polyethylene, butyl rubber, neoprene, polyurethane, or vinyl tested for compatibility with specified glazing sealants of 5 to 10 psi compression strength(25% deflection) as recommended by sealant manufacturers for use in glazing channel to prevent sealant exudation from channel.
PART 3 - EXECUTION

3.01 INSPECTION:

A. Glazier must examine framing and substrate work to receive glass and glazing materials and conditions under which glass is to be installed, and notify the General Contractor, in writing, of conditions detrimental to proper completion of the work. Do not proceed with glazing until unsatisfactory conditions have been corrected in a manner acceptable to Glazier.

3.02 PERFORMANCE REQUIREMENTS:

A. Watertight and airtight installation of each piece of glass is required, except as otherwise shown. Each installation must withstand normal temperature changes, wind loading, and impact loading (for operating sash and doors) without failure, including loss or breakage of glass, failure of sealants or gaskets to remain watertight and airtight, deterioration of glazing materials and other defects in the work.

B. Protect glass from edge damage during handling, installation and operation of building systems/equipment. Glass breakage during warranty period is a form of faulty material or workmanship (resulting from edge damage) unless known to result from vandalism or other causes not related to materials and workmanship.

C. Glazing channel dimensions as shown are intended to provide for necessary minimum bite on glass, minimum edge clearance, and adequate sealant thickness with reasonable tolerances. Glazier is responsible for correct glass size for each opening within tolerances and necessary dimensions established.

3.03 INSTALLATION

A. General and Standards:

1. Comply with combined recommendations of glass manufacturer and manufacturer of sealants and other materials used in glazing, except where more stringent requirements are shown or specified, and except where manufacturers' technical representatives direct otherwise.
2. Unify appearance of each series of lights by setting each piece to match others as nearly as possible. Inspect each piece and set with pattern, drawn, and bow oriented in the same direction as other pieces.

3. Inspect each piece of glass immediately before installation and eliminate pieces which have observable edge damage or face imperfections.

4. Do not attempt to cut, seam, nip or abrade glass which is tempered, heat strengthened, or coated.

5. Cut and install colored (tinted) and heat absorbing glass as recommended in "Technical Document TO-109 and TO-117 (latest edition) by PPG Industries, or similar report by other glass manufacturer.

6. Comply with applicable publications by Flat Glass Marketing Association, except as shown and specified otherwise, and except as specifically recommended otherwise by the manufacturers of the glass and glazing materials.

B. Preparation of Substrate:

1. Clean the glazing channel or other framing member to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to the substrate. Remove lacquer from metal surfaces where elastomeric sealants are used.

2. Apply primer or sealer to joint surfaces where recommended by sealant manufacturer.

C. Sealant/Compound Glazing:

1. Install setting blocks of proper size in sill rabbet, locate at one-fourth of glass width measured from each jamb. Set blocks in thin course of the heel bead compound if heel bead is to be installed.

2. Provide spacers inside and out, and of proper size and spacing for glass sizes larger than 50 united inches, except where pre-shimmed tape or gaskets are used for glazing. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width, except with butyl rubber sealant tape use thickness 1/32" less than final compressed thickness of tape.
3. Voids and Filler Rods: Prevent exudation of sealant or compound by forming voids or installing filler rods in channels at heel of jambs and heads (do not leave voids in sill channels), except as otherwise indicated. In general, voids or filler rods are required for insulating glass and for laminated glass larger than 75 united inches, and for other glass more than 9/32" thick or larger than 120 united inches.

4. Force sealants into channel to eliminate air pockets and voids (other than expansion voids), and to ensure complete "wetting" and bond of sealant to glass and channel surfaces.

5. Tool exposed surfaces of glazing sealants and compounds to provide a substantial "wash" away from glass.

6. When installing processed glass, exercise extraordinary care to avoid contact of glazing materials with processed surfaces, except where concealed in glazing channel. Use masking tape to ensure limitation of compounds to channel area.

7. Clean and trim excess glazing materials from glass and stops or frames promptly after installation, and eliminate stains and discolorations.

D. Gaskets and Tapes:

1. Miter cut and bond ends together at corners where gaskets are used for channel glazing so that gaskets will not pull away from corners and result in voids or leaks in glazing system.

2. Install pressurized tapes and gaskets to protrude slightly out of channel so as to eliminate dirt and moisture pockets. Trim to straight line as required.

3.04 Cure and Protection:

A. Cure glazing sealants and compounds in compliance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength, and surface durability.
B. Glazier shall advise the General Contractor of procedures required for protection of glass and glazing sealants and compounds during construction period so that they will be without deterioration or damage (other than normal weathering) at time of Owner's acceptance.

1. Furnish specific instruction to the General Contractor on precautions and provisions required to prevent glass damage resulting from the alkaline wash from green concrete surfaces and similar sources of possible damage.

2. Protect exterior glass from breakage immediately upon installation by attachment of crossed streamers to framing held away from glass. Do not apply markers directly on surfaces of glass. Except as otherwise indicated, remove applied labels from glass surfaces immediately after glass installation.

3. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during the construction period, including pieces damaged through natural causes, accidents and vandalism.

3.05 CLEANING GLASS:

A. Maintain glass in a reasonably clean condition during construction so that it will not be damaged by corrosive or erosive action and will not contribute (by wash-off) to deterioration of glazing materials and other work.

1. Clean glass in accordance with manufacturer's recommendations. Do not use abrasive materials. On glass, do not use broken razor blades for cleaning.

B. Wash and polish glass on both faces not more than 4 days prior to Owner's acceptance of the work in each area. Comply with glass manufacturer's recommendations.

END OF SECTION 08800
PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. The extent of security glass and glazing work is indicated on the drawings.

1.03 SUBMITTALS:

A. Manufacturer’s Data, Glass: Submit copies of manufacturer’s specifications and installation instructions for each type of glass required. Include test data substantiating that glass complies with specified requirements.

B. Manufacturer’s Data, Glazing Materials: Submit copies of manufacturer’s specifications, and installation instructions for each type of glazing sealant and compound, gasket and associated miscellaneous material required. Include manufacturer’s published data, or letter of certification, or certified test laboratory report indicating that each material complies with the requirements and is intended generally for the applications shown.

C. Samples, Glass: Submit 12” square samples of each type of glass required. Architect’s review of samples will be for color, texture, and pattern only. Compliance with other requirements is the exclusive responsibility of the Contractor. Insulating glass samples need not be hermetically sealed, but edge construction must be included.

D. Guarantee, Laminated Glass: Submit copies of written guarantee, agreeing to replace laminated glass which fails in lamination within 5 years of the date of substantial completion. Failure in lamination is defined to include (but not necessarily limited to) evidence of delamination, loss of transparency, change in color or light transmittance, deterioration of concealed glass coatings or plastic sheet coatings, and other forms of deterioration due to defective materials or workmanship in the laminated glass.
1.04 JOB CONDITIONS:

A. The Contractor must examine the framing and glazing channel surfaces, backing, removable stop design, and the conditions under which the glazing is to be performed, and notify the Architect in writing of any conditions detrimental to the proper and timely completion of the work.

B. Weather Conditions: Do not proceed with installation of liquid sealants under adverse weather conditions, or when temperatures are below or above manufacturer’s recommended limitations for installation.

PART 2 – PRODUCTS

2.01 GLASS (NON-FIRE RATED – DETENTION):

A. Provide 1" clear Secur-Tem + Poly SP028 security glazing as manufactured by Global Security Glazing, Selma, Alabama, 1-800-633-2513.

1. Thickness: .970” nominal/1”.

2. Construction: Symmetrical glass clad polycarbonate with heat strengthened or chemically strengthened glass on both exposed surfaces.

3. Weight: 7.70 pounds/square foot.

4. Performance Testing:
   a. Attack resistance: ASTM F-1915 Grade 1, HP white level IV-TP-0500.02 WMFL level II-60 minute physical attack

5. Max Opening: Any size up to 60” x 96”.

6. Applicable standards:
   a. ANSI Z97.1
   b. CPSC 16 CFR 1201 (CH 1 & 11)
   c. ASTM C1036
   d. ASTM C1349
   e. ASTM C1422
   f. ASTM C1048

2.02 GLAZING SEALANTS/TAPES:

A. General: Glazing sealants and tapes for use with laminated type glass shall be as recommended by the specific glass manufacturer for use with their product and framing assembly into which it is to be installed.
2.03 MISCELLANEOUS GLAZING MATERIALS:

A. Setting Blocks: Neoprene, 70-90 durometer hardness, with proven compatibility with sealants used.

B. Spacers: Neoprene, 40-50 durometer hardness, with proven compatibility with sealants used.

C. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

PART 3 - EXECUTION

3.01 STANDARDS AND PERFORMANCE:

A. Protect glass from edge damage at all times during handling, installation and operation of the building.

B. Glazing channel dimensions as shown are intended to provide for necessary minimum bite on the glass, minimum edge clearance and adequate sealant thicknesses, with reasonable tolerances. The Glazier is responsible for correct glass size for each opening, within the tolerances and necessary dimensions established.

C. Comply with combined recommendations of glass manufacturer and manufacturer of sealants and other materials used in glazing, except where more stringent requirements are shown or specified, and except where manufacturer’s technical representative direct otherwise.

D. Comply with the latest editions of the GANA "Glazing Manual" and the GANA “Sealant Manual” by the “Glass Association of North America” except as shown and specified otherwise, and except as specifically recommended otherwise by the manufacturers of the glass and glazing materials.

E. Inspect each piece of glass immediately before installation, and eliminate any which have observable edge damage or face imperfections.

F. Unify appearance of each series of lights by setting each piece to match others as nearly as possible. Inspect each piece and set with pattern, draw and bow oriented in the same direction as other piece.
3.02 PREPARATION OF GLAZING:

A. Clean the glazing channel, or other framing members to receive glass, immediately before glazing. Remove coatings which are not firmly bonded to the substrate. Remove lacquer from metal surfaces wherever elastomeric sealants are used.

B. Apply primer or sealer to joint surfaces wherever recommended by sealant manufacturer.

C. Clean glass edges and faces to be in contact with sealant or glazing compounds with solvent to remove all traces of cutting oils or other contaminate.

3.03 GLAZING:

A. Install setting blocks of proper size at quarter points of sill rabbet. Set blocks in thin course of the heel-bead compound, if any.

B. Provide spacers inside and out, and of proper size and spacing, for all glass sizes larger than 50 united inches. Provide 1/8" minimum bite of spacers on glass and use thickness equal to sealant width, except with sealant tape use thickness slightly less than final compressed thickness of tape.

C. Do not attempt to cut, seam, nip or abrade glass which is tempered, heat strengthened, or coated.

D. Glazing tapes shall not be lapped at corners. Weld corners together by butting tapes. Recess 3/16 inch below stops.

E. Force sealants into channel to eliminate voids and to ensure complete "wetting" or bond of sealant to glass and channel surfaces.

3.04 CURE AND PROTECTION:

A. Cure glazing sealants in compliance with manufacturer's instructions and recommendations to obtain high early bond strength, internal cohesive strength, and surface durability.

B. Remove and replace glass which is broken, chipped, cracked, abraded or damaged in other ways during the construction period, including pieces damaged through natural causes, accidents and vandalism.

END OF SECTION 08805
SECTION 08810 - FIRE-RATED GLASS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire-rated glazing (FireLite Plus, Pyran Platinum F, Pyran Star F) materials installed as vision lights in non-security fire-rated doors.

B. Related Sections include the following:
   1. Section 08112 - Hollow Metal Work.
   2. Section 08210 - Wood Doors.

1.2 REFERENCES

A. American Society for Testing and Materials (ASTM):

B. American National Standards Institute (ANSI):

C. Consumer Product Safety Commission (CPSC):

D. Glass Association of North America (GANA):

E. National Fire Protection Association (NFPA):

F. Underwriters Laboratories, Inc. (UL):
   1. UL 10N: Fire tests of Door Assemblies.
   2. UL10C: Positive Pressure Fire Tests of Door Assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. FireLite Plus, Pyran Platinum F, Pyran Star F
   1. Fire-rated glass ceramic laminated, clear and wireless glazing material for use in impact safety rated locations such as doors with fire rating requirements ranging from 20 minutes to 3 hours with required hose stream test.

1.4 SUBMITTALS

A. Comply with requirements of Section 01340 “Shop Drawings, Product Data & Samples”.

B. Product data: Submit manufacturer’s technical data for each glazing material required, including installation and maintenance instructions.

B. Certificates of compliance from glass and glazing materials manufacturers attesting that glass and glazing materials furnished for project comply with requirements. Separate certification will not be required for glazing materials bearing manufacturer’s permanent label designating type and thickness of glass, provided labels represent a quality control program involving a recognized certification agency or independent testing laboratory acceptable to authority having jurisdiction.

C. Product Test Listings: From UL indicating fire-rated glass complies with requirements, based on comprehensive testing of current product.

D. Samples: Submit, for verification purposes, approx. 8-inch by 10-inch sample for each type of glass indicated.

1.5 QUALITY ASSURANCE


B. Fire Resistance Rated Glass: Each lite shall bear permanent, nonremovable label of UL certifying it for use in tested and rated fire resistive assemblies.

C. Fire Protective Glazing Products for Door Assemblies: Products identical to those tested per ASTM E-2074-00 and UL10B, labeled and listed by UL.
1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, and handle materials under provisions of Division 1.

B. Deliver materials to specified destination in manufacturer or distributor's packaging, undamaged, complete with installation instructions.

C. Store off ground, under cover, protected from weather and construction activities.

D. Do not expose Pilkington Pyrostop™ or equal to temperatures greater than 120 degrees or less than minimum 40 degrees F during storage and transportation.

   1. Do not expose the non-PVB side of glass to UV light.
   2. Store sheets of glass vertically. DO NOT lean.

1.7 WARRANTY

A. Provide manufacturer's limited warranty under provision of Division 1.

B. Warranty period: Five years from date of substantial completion.

PART 2 - PRODUCTS

2.1 FIRE-RATED GLAZING MATERIALS

A. FireLite Plus: as manufactured by the Nippon Electric Glass Company, LTD and distributed by Technical Glass Products, 8107 Bracken Place SE, Snoqualmie, WA 98065, voice 1-800-426-0279, fax 1-800-451-9857, e-mail sales@fireglass.com, Web site www.fireglass.com.

   1. Properties:
      a. Thickness: 5/16".
      b. Weight: 4 lbs. /s.f.
      c. Approximate Visible Transmission: 85% +/-.
      d. Fire-rating: Provide ratings of 90-minute as indicated on drawings.
      f. STC Rating: 35 dB +/-.
   2. Maximum sheet sizes based on surface finish:

3. Permanently label each piece of FireLite Plus FireLite Logo, UL Logo and Fire rating in sizes up to 3,325 square inches and with the FireLite label only for sizes that exceed the listing (as approved by the local authority having jurisdiction).

4. Fire Rating – Fire rating listed and labeled by UL for fire rating scheduled at opening locations on drawings, when tested in accordance with ASTM E2074-00, NFPA 252, UL 10B and UL10C.

5. Substitutions: Equal products by the following manufacturers will be considered:

2.2 GLAZING COMPOUND FOR FIRE-RATED GLAZING MATERIALS

A. Glazing Tape: Closed cell polyvinyl chloride (PVC) foam, coiled on release paper over adhesive on two sides, maximum water absorption by volume of 2 percent, FireLite Plus glass panels that exceed 1,393 square inches for 90-minute ratings must be glazed with fire-rated glazing tape supplied by the manufacturer.

B. Silicone Sealant: One-part neutral curing silicone, medium modulus sealant, Type S; Grade NS; Class 25 with additional movement capability of 50 percent in both extension and compression (total 100 percent); Use (Exposure) NT; Uses (Substrates) G, A, and O as applicable. Available Products:
   1. Dow Corning 795 – Dow Corning Corp.
   3. Spectrem 2 – Tremco Inc.

C. Setting Blocks:
   1. FireLite Plus:
      a. Neoprene, EPDM or Silicone; tested for compatibility with glazing compound; of 70 to 90 Shore A hardness.
D. Cleaners, Primers, and Sealers: Type recommended by manufacturer of glass and gaskets.

2.3 FABRICATION

A. Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine glass framing, with glazier present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
   2. Minimum required face or edge clearances.
   3. Observable edge damage or face imperfections.

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

C. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates.

3.2 INSTALLATION (GLAZING)

A. FireLite Plus
   1. Comply with referenced FGMA standards and instructions of manufacturers of glass, glazing sealants, and glazing compounds.
   2. Protect glass from edge damage during handling and installation. Inspect glass during installation and discard pieces with edge damage that could affect glass performance.
3. Set units of glass in each series with uniformity of pattern, draw, bow and similar characteristics.

4. Cut glazing tape to length and set against permanent stops, flush with sight lines to fit openings exactly, with stretch allowance during installation.

5. Place setting blocks located at quarter points of glass with edge block no more than 6-inches from corners.

6. Glaze vertically into labeled fire-rated metal frames with the same fire rating as glass and push against tape for full contact at perimeter of pane or unit.

7. Place glazing tape on free perimeter of glazing in same manner described above.

8. Install removable stop and secure without displacement of tape.

9. Install in vision panels in fire-rated doors to requirements of NFPA 80.

10. Install so that appropriate UL and FireLite Plus markings remain permanently visible.

3.3 PROTECTION AND CLEANING

A. Protect glass from contact with contaminating substances resulting from construction operations. Remove any such substances by method approved by glass manufacturer.

B. Wash glass on both faces not more than four days prior to date scheduled for inspections intended to establish date of substantial completion. Wash glass by method recommended by glass manufacturer.

END OF SECTION 08810
PART 1 - GENERAL

1.1 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY:

A. Extent of each type of gypsum drywall construction required is indicated on Drawings.

B. This Section includes the following types of gypsum board construction:
   1. Steel framing members to receive gypsum board.
   2. Gypsum board screw-attached to steel framing and furring members.

1.3 DEFINITIONS:

A. Gypsum Board Construction Terminology: Refer to ASTM C 11 and GA 505 for definitions of terms for gypsum board construction not otherwise defined in this section or other referenced standards.

1.4 SUBMITTALS:

A. Product data from manufacturers for each type of product specified.

1.5 QUALITY ASSURANCE:

A. Fire-Resistance Ratings: Where indicated, provide materials and construction which are identical to those of assemblies whose fire resistance rating has been determined per ASTM E 119 by a testing and inspecting organization acceptable to authorities having jurisdiction.

   1. Provide fire-resistance-rated assemblies identical to those indicated by reference to GA File No's. in GA-600 "Fire Resistance Design Manual" or to design designations in U.L. "Fire Resistance Directory" or in listing of other testing and agencies acceptable to authorities having jurisdiction.
B. Single Source Responsibility: Obtain each type of gypsum board and related joint treatment materials from a single manufacturer.

C. All gypsum board drywall and associated materials shall be manufactured domestically in the United States, by a United States Company and shall conform to ASTM Standards listed herein. Gypsum board drywall and associated materials shall not be imported, rebranded or distributed from another country.

1.6 DELIVERY, STORAGE, AND HANDLING:

A. Deliver materials in original packages, containers or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack gypsum boards flat to prevent sagging.

C. Handle gypsum boards to prevent damage to edges, ends, and surfaces. Do not bend or otherwise damage metal corner beads and trim.

1.7 PROJECT CONDITIONS:

A. Environmental Conditions, General: Establish and maintain environmental conditions for application and finishing gypsum board to comply with ASTM C 840 and with gypsum board manufacturer's recommendations.

B. Minimum Room Temperatures: For nonadhesive attachment of gypsum board to framing, maintain not less than 40 deg F (4 deg C). For adhesive attachment and finishing of gypsum board maintain not less than 50 deg F (10 deg C) for 48 hours prior to application and continuously thereafter until drying is complete.

C. Ventilate building spaces to remove water not required for drying joint treatment materials. Avoid drafts during dry, hot weather to prevent materials from drying too rapidly.
PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturer: Subject to compliance with requirements, provide products of one of the following:

1. Steel Framing and Furring:
   a. Clark Dietrich Framing.
   b. Jaimes Industries, Inc.
   c. Marino/Ware, Division of Ware Industries

2. Gypsum Boards and Related Products:
   b. Georgia Pacific
   c. Certainteed
   d. United States Gypsum

2.2 STEEL FRAMING COMPONENTS FOR SUSPENDED AND FURRED CEILINGS:

A. General: Provide components which comply with ASTM C 754 for materials and sizes, unless otherwise indicated.

B. Concrete Inserts: Inserts designed for attachment to concrete forms and for embedment in concrete, fabricated from corrosion-resistant materials, with holes or loops for attachment of hanger wires and capability to sustain, without failure, a load equal to 3 times that imposed by ceiling construction, as determined from testing per ASTM E 488, conducted by an independent testing laboratory.

C. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft temper.

D. Channels: Cold-rolled steel, 0.0598 inch minimum thickness of base (uncoated) metal and 7/16 inch wide flanges, protected with rust-inhibitive paint, and as follows:

   1. Carrying Channels: 1-1/2 inch deep, 475 lbs per 1000 ft., unless otherwise indicated.
   2. Furring Channels: 3/4 inch deep, 300 lbs per 1000 ft., unless otherwise indicated.

E. Steel Studs for Furring Channels: ASTM C 645, with flange edges bent back 90 deg and doubled over to form 3/16 inch minimum lip (return), minimum thickness of base (uncoated) metal and minimum depth as follows:
1. Thickness: 0.0329 inch, unless otherwise indicated.  
2. Depth: 3-5/8 inches, unless otherwise indicated.

F. Steel Rigid Furring Channels: ASTM C 645, hat-shaped, depth of 1-1/2 inches, and minimum thickness of base (uncoated) metal as follows:

1. Thickness: 0.0329 inch, unless otherwise indicated.

G. Steel Resilient Furring Channels: Manufacturer's standard product designed to reduce sound transmission, complying with ASTM C 645 for material, finish and widths of face and fastening flange, fabricated to form 1/2 inch deep channel of the following configuration:

1. Single-Leg Configuration: Asymmetric-shaped channel with face connected to a single flange by a single slotted leg (web).

H. Grid Suspension System: ASTM C 645, manufacturer's standard grid suspension system composed of main beams and cross furring members which interlock to form a modular supporting network.

2.3 STEEL FRAMING FOR WALLS AND PARTITIONS:

A. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 deg and doubled over to form 3/16" minimum lip (return) and complying with the following requirements for minimum thickness of base (uncoated) metal and for depth:

1. Thickness: 0.0329 inch where indicated.  
2. Depth: 3-5/8 inches, unless otherwise indicated.

B. Steel Rigid Furring Channels: ASTM C 645, hat-shaped, depth and minimum thickness of base (uncoated) metal as follows:

1. Depth: 1-1/2 inches. (7/8” where noted)  
2. Thickness: 0.0329 inch, unless otherwise indicated.

C. Furring Brackets: Serrated-arm type, adjustable, fabricated from corrosion-resistant steel sheet complying with ASTM C 645, minimum thickness of base (uncoated) metal of 0.0329 inch, designed for screw attachment to steel studs and steel rigid furring channels used for furring.
D. Steel Resilient Furring Channels: Manufacturer's standard product designed to reduce sound transmission, complying with ASTM C 645 for base metal, finish and widths of face and fastening flange, fabricated to form 1/2 inch deep channel of the following configuration:

1. Single-Leg Configuration: Assymetric-shaped channel with face connected to a single flange by a single slotted leg (web).

E. Fasteners: Provide fasteners of type, material, size, corrosion resistance, holding power and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum drywall manufacturers for applications indicated.

2.4 GYPSUM BOARD:

A. General: Provide gypsum board of types indicated in maximum lengths available to minimize end-to-end joints.

1. Thickness: Provide gypsum board in thicknesses indicated, or if not otherwise indicated, in either 1/2 inch or 5/8 inch thicknesses to comply with ASTM C 840 for application system and support spacing indicated.

B. Gypsum Wallboard: ASTM C1396, and as follows:

1. Type: Regular, unless otherwise indicated.
2. Type: Foil-backed where indicated.
3. Type: Type X for fire-resistance-rated assemblies.
5. Thickness: 5/8 inch.
6. Products: Subject to compliance with requirements, provide one of the following products where Type X gypsum wallboard is indicated:

   b. "SHEETROCK Brand FIRECODE 'C' Gypsum Panels"; United States Gypsum Co.
   c. Type X gypsum board - Certainteed
   d. Tough Rock Fireguard X gypsum board - Georgia Pacific
C. Gypsum Backing Board for Multi-Layer Applications: ASTM C1396 or, where backing board is not available from manufacturer, gypsum wallboard, ASTM C1396, and as follows:

1. Type: Regular, unless otherwise indicated.
2. Type: Foil-backed where indicated.
3. Type: Type X for fire-resistance-rated assemblies.
4. Edges: Manufacturer's standard.
5. Thickness: 5/8 inch.

D. Water-Resistant Gypsum Backing Board: ASTM C1396, and as follows:

1. Type: Regular, unless otherwise indicated.
2. Type: Type X for fire-resistance-rated assemblies.
3. Thickness: 5/8 inch, unless otherwise indicated.

E. Abuse Resistant Gypsum Wallboard (VHI – Very High Impact) ASTM C1278 and C1629 manufactured to produce greater resistance to surface indentation and through penetration than standard gypsum panels, 5/8” thick with tapered edges.

1. Products:
   a. Gold Bond Hi-Impact brand XP wallboard; National Gypsum Company. (with profoam joint tape and profoam ready mix or setting compound)
   b. Fiberock VHI brand abuse-resistant gypsum panels; United States Gypsum Co.
   c. Air renew extreme impact – Certainteed

F. Acoustically Enhanced Gypsum Board:
1. Thickness: 5/8” Type X
   a. Inner layer: viscoelastic damper polymer
   b. Outer layer: enhanced high density mold resistant gypsum board.
2. Long edges: tapered.
3. Mold Resistance:
   a. ASTM D3273, Score of 10
   b. ASTM G21, score of 0
4. Environmental Requirements: Provide products that comply with testing and product requirements for low emitting materials.
5. STC rated assemblies: For STC rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by independent testing agency.

6. Manufacturers:
   a. Gold Bond-Sound Break XP gypsum board – National Gypsum Company
   b. Silent FX gypsum board – Certainteed
   c. Tough Rock Sound Deadening Board – Georgia Pacific

7. Install per manufacturers specifications with acoustical sealant meeting ASTM C919 and firestopping meeting ASTM E90. Install acoustic sealant at perimeter of boards and around all penetrations. Install putty pads at all receptacles and switch locations. Install fireproofing and fire sealant around all fire rated partitions.

2.5 TRIM ACCESSORIES:

A. Cornerbead and Edge Trim for Interior Installation: Provide corner beads, edge trim and control joints which comply with ASTM C 1047 and requirements indicated below:

1. Material: Formed metal, plastic or metal combined with paper, with metal complying with the following requirement:
   a. Sheet steel zinc-coated by hot-dip process.

2. Edge trim shapes indicated below by reference to designations of Fig. 1 in ASTM C 1047:
   a. "LC" Bead, unless otherwise indicated.
   b. "L" Bead where indicated.
   c. "U" Bead where indicated.

3. One-Piece Control Joint: Formed with vee-shaped slot per Fig. 1 in ASTM C 1047, with slot opening covered with removable strip.

B. Metal Cornerbead and Edge Trim for Exterior Ceilings: Comply with the following requirements:

1. Edge trim complying with ASTM C 1047, formed from rolled zinc, shape "LC" Bead per Fig. 1, unless otherwise indicated.

C. All exterior gypsum corners, including abuse resistant gypsum board (VH1), shall have a cover guard with anchor plate and snap on cover.
D. Adjustable Partition Closure:

1. Double Mullion Mate 4 by Gordon Interiors. Finish to be powder coating to match mullions. Install per manufacturer’s specifications.

2.6 Gypsum Board Joint Treatment Materials:

A. General: Provide materials complying with ASTM C 475, ASTM C 840, and recommendations of manufacturer of both gypsum board and joint treatment materials for the application indicated.

B. Joint Tape: Paper reinforcing tape, unless otherwise indicated.

1. Use pressure sensitive or staple-attached open-weave glass fiber reinforcing tape with compatible joint compound where recommended by manufacturer of gypsum board and joint treatment materials for application indicated.

C. Setting-Type Joint Compounds: Factory-prepackaged, job-mixed, chemical-hardening powder products formulated for uses indicated.

1. Where setting-type joint compounds are indicated for use as taping and topping compounds, use formulation for each which develops greatest bond strength and crack resistance and is compatible with other joint compounds applied over it.

2. For prefilling gypsum board joints, use formulation recommended by gypsum board manufacturer for this purpose.

3. For filling joints and treating fasteners of water-resistant gypsum backing board behind base for ceramic tile, use formulation recommended by gypsum board manufacturer for this purpose.

D. Drying-Type Joint Compounds: Factory-prepackaged vinyl-based products complying with the following requirements for formulation and intended use.


2. All-purpose compound formulated for use as both taping and topping compound.
2.7 MISCELLANEOUS MATERIALS:

A. General: Provide auxiliary materials for gypsum drywall construction which comply with referenced standards and the recommendations of the manufacturer of the gypsum board.

B. Laminating Adhesive: Special adhesive or joint compound recommended for laminating gypsum boards.

C. Spot Grout: ASTM C 475, setting-type joint compound of type recommended for spot grouting hollow metal door frames.


E. Fastening Adhesive for Metal: Special adhesive recommended for laminating gypsum boards to steel framing.

F. Gypsum Board Screws: ASTM C 1002.

G. Gypsum Board Nails: ASTM C 514.

H. Concealed Acoustical Sealant: Nondrying, nonhardening, nonskinning, nonstaining, nonbleeding, gunnable sealant complying with requirement specified in Division-7 section "Joint Sealers."

I. Sound Attenuation Blankets: Unfaced mineral fiber blanket insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with FS HH-1-521 for Type I with class 25 flame spread and as follows:
   1. Mineral Fiber Type: Fibers manufactured from glass.
   2. Use in all partitions.
   3. Equal to USG thermafiber sound attenuation fire blankets (SAFB).

PART 3 - EXECUTION

3.1 EXAMINATION:

A. Examine substrates to which drywall construction attaches or abuts, preset hollow metal frames, cast-in-anchors, and structural framing, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of drywall construction. Do not proceed with installation until unsatisfactory conditions have been corrected.
3.2 Preparation:

A. Ceiling Anchorages: Coordinate installation of ceiling suspension system with installation of overhead structural systems to ensure that inserts and other structural anchorage provisions have been installed to receive ceiling anchors in a manner that will develop their full strength and at spacing required to support ceiling.

3.3 Installation of Steel Framing, General:

A. Steel Framing Installation Standard: Install steel framing to comply with ASTM C 754 and with ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking and bracing at terminations in the work and for support of fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, and similar construction to comply with details indicated and with recommendations of gypsum board manufacturer, or if none available, with "Gypsum Construction Handbook" published by United States Gypsum Co.

C. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement, at locations indicated below to comply with details shown on Drawings:

1. Where edges of suspended ceilings abut building structure horizontally at ceiling perimeters or penetration of structural elements.

2. Where partition and wall framing abuts overhead structure.
   a. Provide slip or cushioned type joints as detailed to attain lateral support and avoid axial loading.

D. Do not bridge building expansion and control joints with steel framing or furring members; independently frame both sides of joints with framing or furring members or as indicated.

3.4 Installation of Steel Framing for Suspended and Furred Ceilings:

A. Secure hangers to structural support by connecting directly to structure where possible, otherwise connect to other anchorage devices or fasteners as indicated.
   1. Do not attach hangers to metal deck tabs.
   2. Do not attach hangers to metal roof deck.
B. Do not connect or suspend steel framing from ducts, pipes or conduit.

C. Keep hangers and braces 2 inches clear of ducts, pipes and conduits.

D. Sway-brace suspended steel framing with hangers used for support.

E. Install suspended steel framing components in sizes and at spacings indicated but not less than that required by referenced steel framing installation standard.

1. Wire Hangers: 0.1620 inch diameter (8 gage), 4 ft. on center.

2. Carrying Channels (Main Runners): 1-1/2 inch, 4 ft. on center.

3. Rigid Furring Channels (Furring Members): 16 inches on center.

4. Rigid Furring Channels (Furring Members): 24 inches on center.

F. Installation Tolerances: Install steel framing components for suspended ceilings so that cross furring members or grid suspension members are level to within 1/8 inch in 12 ft. as measured both lengthwise on each member and transversely between parallel members.

G. Wire-tie or clip furring members to main runners and to other structural supports as indicated.

3.5 INSTALLATION OF STEEL FRAMING FOR WALLS AND PARTITIONS:

A. Install runners (tracks) at floors, ceilings and structural walls and columns where gypsum drywall stud system abuts other construction.

1. Where studs are installed directly against exterior walls, install asphalt felt strips between studs and wall.

B. Installation Tolerances: Install each steel framing and furring member so that fastening surface do not vary more than 1/8 inch from plane of faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended
ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

D. Terminate partition framing at suspended ceilings only where specifically indicated.

E. Install steel studs and furring in sizes and at spacings indicated but not less than that required by referenced steel framing installation standard.

1. For single layer construction: 16 inches on center.

F. Install steel studs so that flanges point in the same direction and gypsum boards can be installed in the direction opposite to that of the flange.

G. Frame door openings to comply with details indicated, with GA-219 and with applicable published recommendations of gypsum board manufacturer. Attach vertical studs at jambs with screws either directly to frames or to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

1. Extend vertical jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

H. Frame openings other than door openings to comply with details indicated, or if none indicated, in same manner as required for door openings; and install framing below sills of openings to match framing required above door heads.

3.6 APPLICATION AND FINISHING OF GYPSUM BOARD, GENERAL:

A. Install abuse resistant gypsum board (VH1) typical where indicated on drawings.

B. Gypsum Board Application and Finishing Standard: Install and finish gypsum board to comply with ASTM C 840.

C. Install sound attenuation blankets prior to gypsum board unless readily installed after board has been installed.

D. Locate exposed end-butt joints as far from center of walls and ceilings as possible, and stagger not less than 24 inches in alternate courses of board.
E. Install ceiling boards across framing in the manner which minimizes the number of end-butt joints, and which avoids end joints in the central area of each ceiling. Stagger end joints at least 24 inches.

F. Install wall/partition boards in manner which minimizes the number of end-butt joints or avoids them entirely where possible. At stairwells and similar high walls, install boards horizontally with end joints staggered over studs.

G. Install exposed gypsum board with face side out. Do not install imperfect, damaged or damp boards. Butt boards together for a light contact at edges and ends with not more than 1/16 inch open space between boards. Do not force into place.

H. Locate either edge or end joints over supports, except in horizontal applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered edges and mill-cut or field-cut ends against mill-cut or field-cut ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.

I. Attach gypsum board to steel studs so that leading edge or end of each board is attached to open (unsupported) edge of stud flange first.

J. Attach gypsum board to supplementary framing and blocking provided for additional support at openings and cutouts.

K. Spot grout hollow metal door frames for solid core wood doors, hollow metal doors and doors over 32 inches wide. Apply spot grout at each jamb anchor clip just before inserting board into frame.

L. Form control joints and expansion joints at locations indicated, with space between edges of boards, prepared to receive trim accessories.

M. Cover both faces of steel stud partition framing with gypsum board in concealed spaces (above ceilings, etc.), except in chase walls which are braced internally.

1. Except where concealed application is indicated or required for sound, fire, air or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. area, and may be limited to not less than 75 percent of full coverage.
2. Fit gypsum board around ducts, pipes, and conduits.

N. Isolate perimeter of non-load-bearing drywall partitions at structural abutments. Provide 1/4 inch to 1/2 inch space and trim edge with "U" bead edge trim. Seal joints with acoustical sealant.

O. At all drywall partitions, seal construction at perimeters, control and expansion joints, openings and penetrations with a continuous bead of acoustical sealant including a bead at both faces of partitions. Comply with ASTM C 919 and manufacturer's recommendations for location of edge trim, and close off sound-flanking paths around or through construction, including sealing of partitions above acoustical ceilings.

P. Space fasteners in gypsum boards in accordance with referenced gypsum board application and finishing standard and manufacturer's recommendations.

3.7 METHODS OF GYPSUM BOARD APPLICATION:

A. Single-Layer Application: Install gypsum wallboard as follows:

1. On ceilings apply gypsum board prior to wall/partition board application to the greatest extent possible.

2. On partitions/walls apply gypsum board vertically (parallel to framing), unless otherwise indicated, and provide sheet lengths which will minimize end joints.

3. On partitions/walls 8'-1" or less in height apply gypsum board horizontally (perpendicular to framing); use maximum length sheets possible to minimize end joints.

B. Double-Layer Application: Install gypsum backing board for base layer and gypsum wallboard for face layer.

1. On ceilings apply base layer prior to application of base layer on walls/partitions; apply face layers in same sequence. Offset joints between layers at least 10 inches. Apply base layers at right angles to supports unless otherwise indicated.

2. On partitions/walls apply base layer and face layers vertically (parallel to framing) with joints of base layer over supports and face layer joints offset at least 10 inches with base layer joints.
C. Acoustical Tile Base: Where drywall is base for adhesively applied acoustical tile, install gypsum backing board.
   1. Provide either V-joint type backing board or tape and finish joints to produce a flat surface.

D. Single-Layer Fastening Methods: Apply gypsum boards to supports as follows:
   1. Fasten with screws.

E. Double-Layer Fastening Methods: Apply base layer of gypsum board and face layer to base layer as follows:
   1. Fasten both base layers and face layers separately to supports with screws.

F. Direct-Bonding to Substrate: Where gypsum board is indicated to be directly adhered to a substrate (other than studs, joists, furring members or base layer of gypsum board), comply with gypsum board manufacturer's recommendations, and temporarily brace or fasten gypsum board until fastening adhesive has set.

3.8 INSTALLATION OF DRYWALL TRIM ACCESSORIES:

A. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten gypsum board to the supports. Otherwise, fasten flanges to comply with manufacturer's recommendations.

B. Install corner beads at external corners.

C. Install metal edge trim whenever edge of gypsum board would otherwise be exposed or semi-exposed, and except where plastic trim is indicated. Provide type with face flange to receive joint compound except where "U" bead (semi-finishing type) is indicated.
   1. Install "LC" bead where drywall construction is tightly abutted to other construction and back flange can be attached to framing or supporting substrate.
   2. Install "L" bead where edge trim can only be installed after gypsum board is installed.
   3. Install U-type trim where edge is exposed, revealed, gasketed, or sealant-filled (including expansion joints).
D. Install plastic edge trim where indicated on wall panels at juncture with ceilings.

E. Window Frame Closure

F. Install control joints at locations indicated, or if not indicated, at spacings and locations required by referenced gypsum board application and finish standard, and approved by the Architect for visual effect.

3.9 FINISHING OF DRYWALL:

A. General: Apply joint treatment at gypsum board joints (both directions); flanges of corner bead, edge trim, and control joints; penetrations; fastener heads, surface defects and elsewhere as required to prepare work for decoration.

B. Prefill open joints and rounded or beveled edges, if any, using setting-type joint compound.

C. Apply joint tape at joints between gypsum boards, except where trim accessories are indicated.

D. Finish interior gypsum wallboard by applying the following joint compounds in 3 coats (not including prefill of openings in base), and sand between coats and after last coat:

1. Embedding and First Coat: Setting-Type Joint Compound.

2. Fill (Second) Coat: Setting-type joint compound.

3. Finish (Third) Coat: Ready-mix drying-type all-purpose or topping compound.

4. Provide a Level 5 gypsum board finish at all Abuse Resistant (VHI) gypsum board locations, unless noted otherwise.

E. Base for Acoustical Tile: Where gypsum board is indicated as a base for adhesively-applied acoustical tile, install tape and 2-coat compound treatment, without sanding.

F. Partial Finishing: Omit third coat and sanding on concealed drywall construction which is indicated for drywall finishing or which requires finishing to achieve fire-resistance rating, sound rating or to act as air or smoke barrier.
3.10 PROTECTION:

A. Provide final protection and maintain conditions, in a manner suitable to Installer, which ensures gypsum drywall construction being without damage or deterioration at time of Substantial Completion.

END OF SECTION 09250
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. The extent of tile work is shown on drawings and in schedules.

1.03 QUALITY ASSURANCE:

A. Qualifications of Installers:

1. For installation of ceramic tile, use only thoroughly trained and experienced personnel completely familiar with specified products, manufacturer's recommended methods of installation and requirements established for this work.

B. Codes and Standards:

2. Comply with ANSI and ASTM Standards listed within this Section.

C. Proprietary Materials: Handle, store, mix and apply proprietary setting and grouting materials in compliance with manufacturer's instructions.

1.04 SUBMITTALS:

A. Product Data:

1. For information only, submit two (2) copies of manufacturer's technical information and install instructions for all materials required, except bulk materials. Include certifications and other data as may be required to show compliance with these specifications. Transmit a copy of each instruction to the Installer.
2. Accompany materials list with two (2) copies of manufacturer's current recommended method of installation for each item. These recommendations, after review by the Installer/Contractor and Architect/Engineer, shall form basis for acceptance or rejection of installed work.

B. Samples:

1. Submit three (3) samples of each type and color of tile required, not less than 12" square on plywood or hardboard backing and grouted. Submit samples of trim and 6" long sample of marble threshold. Review will be for color, pattern and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

1.05 DELIVERY AND STORAGE:

A. Deliver packaged materials and store in original containers with seals unbroken and labels in tact until time of use, in accordance with manufacturer's instructions.

PART 2 – PRODUCTS

2.01 MATERIALS:

A. Porcelain Ceramic Tile

1. Shall meet requirements of TCA 137.1 and requirements of this Section.
   a. Porcelain pavers for Toilet Room floors shall be:
      1. Virginia Tile
         a. Stratos line
            1. Color: Avorio, matt finish
            2. Size: 12” x 12” (quarter turn)
            3. 6” cove base to be installed offset.
         b. Available from: Virginia Tile
            a. Contact: Kathleen Somerville, 248-467-4362
b. Porcelain ceramic tile for Toilet Room walls shall be:
   1. Virginia Tile
      a. CTI/Encore line, matte finish.
         1. Color: Crystal
         2. Size: 12” x 24” (1/3 offset)
      b. Available from: Virginia Tile
         1. Contact: Kathleen Somerville, 248-467-4362

c. Porcelain pavers for Lobby/Corridor floor (Floors-1 only) (field) shall be:
   1. Stone peak
      a. Simply Modern collection
         1. Color: Simply crème, matt finish
         2. Size: 24” x 24” Straight lay
      b. Available from: Genesee Ceramic Tile
         1. Contact: Erin Chesley cell 810-459-0229

d. Porcelain pavers for Lobby/Corridor floor (accent border) shall be:
   1. Stone peak
      a. Plane line
         1. Color: White Plane Chrome finish
         2. Size: 24” x 24” (see plans)
      b. Available from: Genesee Ceramic Tile
         1. Contact: Erin Chesley cell 810-459-0229

e. Porcelain ceramic tile for Lobby/Corridor wall base shall be:
   1. Stone peak
      a. Plane line
         1. Color: White Plane, honed finish
         2. Size: 6” high
      b. Available from: Genesee Ceramic Tile
         1. Contact: Erin Chesley cell 810-459-0229
f. Porcelain Ceramic Tile for Lobby/Corridor wall, lower portion (6” to 36” A.F.F) (Floors 1-13) shall be:
   1. Stone Peak
      a. Plane line
         1. Color: White Plane, honed finish
         2. Size: 30” x 30” (see elevations)
      b. Available from: Genesee Ceramic Tile
         1. Contact: Erin Chesley cell 810-459-0229

g. Porcelain Panel for Courtrooms (wall behind Judge in Rooms):
   1. Maximum Fiandre Extralite
      a. Marmi Maximum
         1. Color: Travertino
         2. Size: 2′-0” x 2′-0” and 2′-0” x 4′-0” (see elevations)
      b. Available from: Dwyer Marble & Stone
         1. Contact: Joe Lack, (248) 752-2863

h. Miscellaneous
   1. 5′ diameter water jet logo
   2. Stone Peak Plane Line
      a. Colors to be determined (multiple colors will be used)
   3. Camera ready artwork (Shelby Township) will be provided by Owner.

B. Marble Thresholds: Marble thresholds shall be 1/2" inch high with chamfered edges of a uniform, fine to medium grained white stone with gray veining and conform to ASTM C503 with a minimum abrasion resistance of ten (10) per ASTM C1353 or ASTM C241 and with a honed finish.

C. Finish/Edge Protection Profiles
   1. Provide profiles as indicated below and on drawings as manufactured by Schluter Systems L.P., 194 Pleasant Ridge Road, Plattsburgh, NY 12901-5841, 1-800-472-4588, fax 1-800-477-9783 www.schluter.com
a. Corner Guard
   1. Schluter ECK-E: Roll formed type 304 (V2A) steel V-shaped profile with 1-15/32 inch (37mm) wide exposed surfaces joined by a symmetrically rounded corner with integrated trapezoid-perforated anchoring legs.
   2. Provide full height of all wall and column outside corners.

b. Border Profile
   1. Schluter Quad-EC: Profile with square visible surface, integrated trapezoid-perforated anchoring leg, and integrated grout joint spacer in stainless steel type 304 (V2A).
   2. Provide between porcelain tile wall and masonry or HM/steel/aluminum surfaces.
   3. Provide separation (bituminous coating) between stainless steel and aluminum.

c. Floor Transition
   1. Schluter SCHIENE - E: Profile with trapezoid perforated anchoring leg, with 5° sloped top flange and fillet at the anchoring leg/vertical section interface, in stainless steel type 304 (V2A).
   2. Provide with special perforations to radius. Provide as indicated on drawings.

d. `Full Height Tile Transition
   1. Schluter QUADEC strip between 30” x 30” and 30” x 60” full height tile. Maintain Schluter strip on all wainscoting for a uniform look.

2.02 SETTING MATERIALS

A. MEDIUM SET MORTAR - For all large format tile:

   1. Description: Factory prepared mortar and latex additive; complying with ANSI A118.4 and ISO standards C2TES1P1. Medium bed thickness; 3/8 to 3/4 inch thick floor installation.
   2. Color: Gray
   3. Acceptable Products:
      a. MAPEI UltraFlex LFT, complies with ANSI A118.4
      b. Custom Building Products, MegaLite.
      c. Laticrete, 4XLT.
      d. R-C Ultimate Mortar
      e. TEC, Ultimate large mortar
B. Latex-Portland Cement Mortar: ANSI A118.4, composed as follows:

1. Mixture of Dry-Mortar Mix and Latex Additive: Mixture the prepackaged dry-mortar mix and liquid-latex additive complying with the following requirements:
2. Provide one of the following products:
   a. Mapei, Elk Grove Village, IL; Kerabond/Keralastic
   b. Custom Building Products, Custom Blend/Custom Flex
   c. Laticrete, Bethany, CT; Laticrete 272/333
   d. TEC, Palatine, IL; Full set plus/Xtra Flex Additive

C. Waterproofing and Crack Isolation Membrane: Provide materials complying with ANSI A118.10 and ANSI A118.12 and as specified below. Note: All wall and floor tile shall be installed on a crack isolation membrane:

1. Mapelastic AquaDefense as manufactured by MAPEI Corp.
3. Hydroment ultra-set advanced as manufactured by Bostik, Inc.
5. Hydraflex as manufactured by TEC. Ready to use, flexible, mold and mildew resistant waterproofing and crack isolation membrane for interior and exterior applications.

D. Crack Isolation membrane in corridors and lobby areas: Provide materials complying with ANSI A118.12 and as specified below:

1. Mapeguard 2, as manufactured by MAPEI Corp.

2.03 GROUTING MATERIALS

A. Epoxy-modified Grout Admixture: Complying with ANSI A118.8 and A118.3.

1. Provide one of the following manufacturers:
   a. Mapei, Kerapoxy.
   b. Custom Building Products, 100 Solids Epoxy Grout
   c. TEC, EFX 100% Epoxy Grout
   d. Laticrete, Bethany, CT, Spectralock Pro Grout.
B. TEC for walls In Color Advanced Performance Grout.

C. Color: As selected by Architect.

2.04 MISCELLANEOUS MATERIAL

A. Latex Underlayment: Quick set type, as recommended by membrane manufacturer, as required to provide positive drainage to floor drains.

B. Seal for Porcelain Ceramic Tile: Shall be a penetrating sealer as manufactured by Aqua Mix Inc., Santa Fe Springs, California, Miracle Sealants Penetrating Sealer, Arcadia, California, or Architect approved equivalent. (Seal prior to grouting)

C. Sealants for control joints in floors and walls, use one part fungicidal silicone rubber to match grout:

1. Dow Corning 784
2. Laticrete Latasil silicone sealant meeting Fed. Spec. TT-S-001543, Class A or B.
3. TEC AccuColor 100, 100% silicone sealant low VOC ASTM C920.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Installer must examine the areas and conditions under which tile work is to be installed and notify the General Contractor, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 PREPARATION:

A. Prepare substrate to receive setting bed and tile recommended both by the manufacturer of the tile and of the setting bed materials.

1. Fill cracks, holes and depressions with trowelable leveling and patching compound according to tile setting material manufacturer’s written instructions.
2. Remove protrusions, bumps and ridges by sanding or grinding.
4. Apply skim coat full height to all walls to receive wall tile.
5. Apply self leveling agent to entire floor to receive floor tile.

B. Clean substrate as required and recommended to achieve bond using cleaners, detergents, etc.

C. Neutralize and seal substrates as recommended.

3.03 INSTALLATION:

A. Tile Installation - General:

1. Provide installation of ceramic tile in accordance with the latest edition of the Tile Council of America's "Handbook for Ceramic Tile Installation."

2. Fit tile carefully against trim and around pipes, electrical boxes and other built-up fixtures so that escutcheons, plates and collars will completely overlap cut edges.

3. Smooth exposed edges and clean tile before installation.

4. Install ceramic tile with a nominal 1/8" joint (unless noted otherwise or otherwise recommended by the tile manufacturer).

5. Joint designs shall be symmetrical within room or area; border tile be not less than 1/2 normal width. Floor tile shall be set in straight line design, with bullnose joints in alignment with floor tile where possible.

6. At junction of base tile and bullnose base tile, at projections through tile and at junctions of tile to corner guards and similar equipment, leave joint ungrouted for sealing.

7. When using tile sheets, minimize tearing sheets apart.

3.04 SETTING METHODS

A. Method and typical detailing for tile work shall be in accordance with the following TCA alphanumeric method, listing from the "Handbook for Ceramic Tile Installation", latest edition, by the Tile Council of America.
B. Concrete Subfloors

1. Slabs on grade and above grade (full set method): TCA setting method F114-14 (provide with waterproof and crack isolation membrane) full set Portland cement mortar; epoxy grout A118.3 complying with tile installation specification ANSI A118.4 and epoxy grout installation specification ANSI A108.6. Install crack isolation membrane per manufacturer’s specs.

C. Walls


3.05 GROUTING

A. Grouting shall be installed in accordance with ANSI A108.10 and the manufacturer's recommended procedures and precautions during application and cleaning.

B. Rinse tilework thoroughly with clean water before and after using chemical cleaners.

C. Base Installation:


D. Jointing Pattern: Lay tile in pattern indicated. Layout tile work and enter tile fields both directions in such space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint width, unless otherwise shown.

E. Expansion and Control Joints: Provide as recommended by TCA and by tile and setting bed and grouting material manufacturer and as follows:

1. Control Joints Locations: Comply with the Tile Council of America, (TCA) and where/if indicated.
a. Interior Locations (horizontal and vertical):

1. Over any existing expansion joint, control joint, cold joint or seismic joint in the building structure.
2. Expansion joints – 24 feet to 36 feet in each direction.
3. Expansion joints – 8 feet to 12 feet where tile work located in direct sunlight or moisture locations.
4. Where tile abuts restraining surfaces such as perimeter walls, dissimilar floors, curbs, columns, pipes, and where changes occur in backing materials.
5. Coordinate joint locations with the Architect and for other areas indicated or required.
6. Joint width shall be 3/8 inch, unless otherwise indicated.
7. Provide under-layment systems.
8. Install compatible sealant and color approved by the Architect.

F. Grout all tile using commercial epoxy grout as specified.

1. Temporarily protect tile as required to prevent staining.

3.04 ADJUST AND CLEAN:

A. Cleaning:

1. Clean grout and setting materials from face of tile while materials are workable. Leave tile face clean and free of all foreign matter.

2. Tile may be cleaned with acid solutions only when permitted by the tile and grout manufacturer's printed instructions, but not sooner than 14 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush the surface with clean water before and after cleaning.

B. Finished Tile Work:

1. Leave finished installation clean and free of cracked, chipped, broken, unbonded, or otherwise defective tile work.
C. Protection:

1. Apply a protective coat of neutral protective cleaner to completed tile work.

2. Protect installed tile work with Kraft paper or other heavy covering during the construction period to prevent damage and wear.

3. Prohibit all foot and wheel traffic from using tiled floors for at least 3 days, preferably 7 days.

4. Before final inspection, remove protective coverings and rinse neutral cleaner from all tile surfaces.

END OF SECTION 09300
PART 1 - GENERAL

1.01 RELATED DOCUMENTS:
A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:
A. The extent of acoustical panel ceiling is shown on the drawings and in schedules.

1.03 QUALITY ASSURANCE:
A. The installation of acoustical panel ceilings is to be by an experienced installation firm which is acceptable to the manufacturer of the acoustical units, as shown by current written statement from the manufacturer.
C. Fire Hazard Classification: UL tested, listed and labeled as Class 0.25.

1.04 SUBMITTALS:
A. Product Data:
1. For information only, submit 2 copies of manufacturer's product specifications and installation instructions for each acoustical panel ceiling material required, and for suspension system, including certified laboratory test reports and other data as required to show compliance with these specifications. Distribute one additional copy of each installation instruction to the Installer.
   a. Include manufacturer's recommendations for cleaning and refinishing acoustical panel, including precautions against materials and methods which may be detrimental to finishes and acoustical performance.
1.05 SAMPLES

1. Submit 3 sets of 12" square Samples for each acoustical panel required. In each set of samples show the full range of exposed color and texture to be expected in the completed work. Sample submittal and Architect's review will be for color and texture only. Compliance with other requirements is the exclusive responsibility of the Installer.

2. Submit 3, 12" long samples of exposed runner and molding. Architect's review will be for color and texture only. Compliance with other requirements is the exclusive responsibility of the Installer.

C. Maintenance Stock:

1. At the time of completing the installation, deliver stock of maintenance materials to the Owner. Furnish full size units matching the units installed, packaged with protective covering for storage and identified with appropriate labels. Furnish an amount equal to 5.0% of the amount installed.

1.06 JOB CONDITIONS:

A. Space Enclosures: Do not install until interior acoustical panel ceilings unit space has been enclosed and is weather-tight, and until wet work in the space has been completed and is nominally dry and until work above ceilings has been completed, and until ambient conditions of temperature and humidity will be continuously maintained at values near those indicated for final occupancy.

PART 2 - PRODUCTS

2.01 CEILING UNITS:

A. Acoustical Panels: (ACT-1)

1. Provide 24" x 24" wet-formed mineral fiber units with Durabrite acoustically transparent membrane not less than 3/4" thick. NRC 0.75, AC170, CAC 35, light reflectance 0.89, beveled tegular edge.
2. Acceptable Products:
   a. Armstrong Item No. 1942 “Ultima Open Plan”

3. Install in 9/16" exposed tee grid.

B. Acoustical Panels: (ACT-2) Toilet & Storage Rooms

1. Provide 2 x 2 fiberglass units with a scrubbable vinyl film facing (UV protected), not less than 5/8” thick. NRC min. 0.70, CAC, light reflectance min. 0.72.

2. Acceptable Products:
   a. Armstrong Item No. 2908 perforated “Random Fissured”.
   b. Certainteed: Item No. 1532-VINP-1 “Versatone White Vintage Perforated”.
   c. USG: Item No. 7054G “Premier Hi-lite ClimaPlus”- “Kapok”.

3. Install in 15/16" exposed tee grid.

2.03 CEILING SUSPENSION MATERIALS:

A. General: Comply with ASTM C 635, as applicable to an intermediate duty suspension system. Coordinate with other work supported by or penetrating through the ceilings, including light fixtures and HVAC equipment.

B. Attachment Devices: Size for 5 times the design load indicated in ASTM C 635, Table 1, Direct Hung.

1. Hanger Wires: Galvanized carbon steel, ASTM A 641, soft temper, prestretched, yield-stress load of at least 3 times design load but not less than 12 USWG.

C. Exposed Suspension System: Exposed systems compatible with tiles specified and as follows:

1. 15/16” Systems
   a. Armstrong - 15/16" Prelude XL exposed tee grid.
   b. CertainTeed - 15/16” Classic Aluminum Capped Stab System.
   c. Donn - DX24 System; USG Interiors
   d. Chicago Metallic Corp: 1200 System.
2. 9/16” Systems
   a. Armstrong - 9/16” Suprafine exposed tee grid system.
   b. CertainTeed - Elite narrow slab system.
   c. Donn - Centricitee ceiling grid DXT; USG Interiors.
   d. Chicago Metallic Corp: Tempra 4000.

D. Edge Moldings: Manufacturer's standard channel molding for grid type used for edges and penetrations of ceiling, with a single flange of molding exposed, finish to match grid.

2.04 MISCELLANEOUS MATERIALS:
   A. Acoustical Sealant: A heavy-bodied, non-shrinking, non-drying, non-sag grade mastic compound intended for interior sealing of concealed construction joints.
   B. Tile Cement: As recommended by tile manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION AND PREPARATION WORK:
   A. Installer must examine the conditions under which the acoustical ceiling work is to be performed and notify the General Contractor, in writing, of unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
   B. Measure each ceiling area and establish layout of acoustical units to balance border widths at opposite edges of each ceiling. Avoid the use of less-than-half widths units at borders, and comply with reflected ceiling plans wherever possible.

3.02 INSTALLATION:
   A. General: Install material in accordance with manufacturer's printed instructions and comply with governing regulations as indicated, and industry standards applicable to the work.
   B. Install suspension systems to comply with ASTM C 636 with hangers supported only from building structural members as indicated. Locate hangers near each end and spaced 4' - 0' along direct-hung runners, unless otherwise indicated.
1. Secure wire hangers by looping and wire-tying, either directly to structures or to inserts, eye-screws, or other devices which are secure and appropriate for the substrate, and which will not deteriorate or fail with age or elevated temperatures.

C. Install edge moldings at edges of each acoustical ceiling area and at locations where edge of units would otherwise be exposed after completion of the work, except where adhesively applied.

   1. Sealant Bed: Apply continuous ribbon of acoustical sealant, concealed pm back of vertical leg before fastening to vertical surface.

   2. Secure moldings to building construction by fastening with screw-anchors into the substrate through holes drilled in not more than 16" o.c. along each molding.

   3. Level moldings with ceiling suspension system to level tolerance of 1/8" in 12' - 0".

   4. Miter corners of moldings accurately to provide hair-line joints, securely connected to prevent dislocation.

D. Cope exposed flanges of intersection suspension system members so that flange faces will be flush (cope flange of member supported by other member) except as otherwise indicated.

E. Install acoustical panels in coordination with suspension system, with edges concealed by support of suspension members. Scribe and cut panels to fit accurately at penetrations.

F. Install edge trim moldings where indicated and elsewhere as needed to conceal edges of acoustical units which would otherwise be exposed to view after completion of the work. Anchor with fasteners, or if not possible, secure in place with permanent adhesive.
3.03 CLEANING AND PROTECTION:

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension members; comply with manufacturer's instructions for cleaning and touch-up of minor finish damage. Remove and replace work which cannot be successfully cleaned and required to permanently eliminate evidence of damage.

B. The Installer shall advise the General Contractor of required protection for the acoustical panel ceilings, including temperature and humidity limitations and dust control, so that the work will be without damage and deterioration at the time of acceptance by the Owner.

END OF SECTION 09510
SECTION 09540 – SPECIAL SURFACES

PART 1 – GENERAL

1.01 DESCRIPTION

A. Work described in this section:
   1. Window Sills (indicated as synthetic sill material on drawings).
   2. Countertops and Trim where indicated.

B. Related work specified elsewhere:
   1. Section 06100 – Carpentry
   2. Section 09250 – Gypsum Drywall

1.02 REFERENCES

A. Applicable Standards: Standards of the following, as referenced herein:
   1. American National Standards Institute (ANSI)
   3. National Electrical Manufacturers Association (NEMA)
   4. Federal Specifications (FS)

1.03 SUBMITTALS

A. Shop drawings: Indicate dimensions, component sizes, fabrication details, attachment provisions and coordination requirements with adjacent work.

B. Samples: Submit minimum 2” x 2” (50mm x 50mm) samples. Indicate full range of color and pattern variation. Approved samples will be retained as standards for work.

C. Product data: Indicate product description, fabrication information and compliance with specified performance requirements.

D. Maintenance data: Submit manufacturer’s care and maintenance data, including repair and cleaning
instructions. Include in project close-out documents.

1.04 QUALITY ASSURANCE

A. Allowable tolerances:
   1. Variation in component size: ± 1/8” (3 mm).
   2. Location of openings: ± 1/8” (3 mm) from indicated location.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver no components to project site until areas are ready for installation. Store components indoors prior to installation.

B. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent physical damage or staining following installation for duration of project.

1.06 WARRANTY

A. Provide manufacturer’s 10 year warranty against defects in materials. Warranty shall provide material and labor to repair or replace defective materials. Damage caused by physical or chemical abuse or damage from excessive heat will not be warranted.

PART 2 - PRODUCTS

2.01 SOLID POLYMER FABRICATIONS

A. Material: Homogeneous filled acrylic; not coated, laminated or of composite construction; meeting ANSI Z124.3 & .6, Type Six, and Fed. Spec. WW-F-541E/GEN.

   1. Material shall have minimum physical and performance properties specified in the following Section U.

   2. Superficial damage to a depth of 0.010”
(.25mm) shall be repairable by sanding and polishing.

B. Manufacturer:
   1. Corian (Basis of Design)
   2. Newmar
   3. Gibraltar
   4. Avonite
   5. Prism as manufactured by InPro Corp.

C. Windowsills (pre-finished sills): ½" thick solid polymer, as shown on drawings, adhesively joined with inconspicuous seams; edge details as indicated on the Architects drawings. Color to be selected by Architect from manufacturer’s standard and/or custom colors from all price groups.

D. Countertops & Trim: ¾" or ½" thick solid polymer, as shown on drawings, adhesively joined with inconspicuous seams; edge details as indicated on the Architects drawings. Color to be as follows:

   1. Restroom solid surface countertops:
      a. Corian: Clam Shell
   2. Window sills public lobby
      a. Corian: TO BE DETERMINED
   3. Window sills – non public areas
      a. Corian: TO BE DETERMINED

2.02 ACCESSORY PRODUCTS

A. Joint adhesive: Manufacturer’s standard two-part adhesive kit to create inconspicuous, non-porous joints, with a chemical bond.

B. Sealant: Manufacturer’s standard mildew-resistant, FDA/UL recognized silicone sealant in color matching or clear formulations.

2.03 FABRICATION

A. Fabricate components in shop to greatest extent practical to sizes and shapes indicated, in accordance with approved shop drawings and manufacturer’s requirements.
B. Form joints between components using manufacturer’s standard joint adhesive. Joints shall be inconspicuous in appearance and without voids. Attach 2” (50 mm) wide reinforcing strip of solid surface under each joint.

C. Rout and finish component edges to a smooth, uniform finish. Rout all cutouts, then sand all edges smooth. Repair or reject defective or inaccurate work.

D. Finish: All surfaces shall have uniform finish.
   1. Matte, with a gloss rating of 5-20.

E. Thermoforming: Comply with forming data from manufacturer.
   1. Construct matching molds of plywood to form component shape.
   2. Form pieces to shape prior to seaming and joining.
   5. Prevent blistering, whitening and cracking of solid surface during forming.

PART 3 – EXECUTION

3.01 JOB MOCK-UP

A. Prior to final approval of shop drawings, erect one full size mock-up of each component at project site for Architect review.

B. Should mock-up not be approved, rework or remake
until approval is secured. Remove rejected units from project site.

C. Approved mock-ups shall remain as part of finished work.

3.02 INSTALLATION

A. Install components plumb and level, in accordance with approved shop drawings and product installation details.

B. Form field joints using manufacturer’s recommended adhesive, with joints inconspicuous in finished work. Keep components and hands clean when making joints.

C. Keep components and hands clean during installation. Remove adhesives, sealants and other stains. Components shall be clean on Date of Substantial Completion.

D. Protect surfaces from damage until Date of Substantial Completion. Repair or replace damaged work that cannot be repaired to Architect’s satisfaction.

E. Fabricator/Installer is to provide manufacturers recommended manuals, and review maintenance procedures and the manufacturer’s warranty with the head of Maintenance upon completion of the project.
SECTION 09650 - RESILIENT FLOORING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. The extent of resilient flooring and accessories is shown on the drawings and in schedules.

1.03 QUALITY ASSURANCE:

A. Wherever possible, provide resilient flooring and accessories produced by a single manufacturer.

B. Fire Test Performance: Provide resilient flooring which complies with the following fire test performance criteria as determined by an independent testing laboratory acceptable to authorities having jurisdiction.

1. Critical Radiant Flux (CRF): Not less than 0.45 watts per sq. cm. per ASTM E 648.

2. Flame Spread: Not more than 75 per ASTM E 84.

3. Smoke Developed: Not more than 450 per ASTM E 84.

4. Smoke Density: Not more than 450 per ASTM E 662.

1.04 SUBMITTALS:

A. Product Data:

1. For information only, submit 2 copies of manufacturer's technical data and installation instructions for each type of resilient flooring and accessory. Transmit a copy of each installation instruction to the Installer.
B. Samples:

1. Submit 3 sets of samples of each type, color and finish of resilient flooring and accessory required. Provide full-size tile units and 6" long sample of accessory. Include full range of flooring color and pattern variation. Sample submittals will be reviewed for color, texture and pattern only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

C. Maintenance:

1. Submit 2 copies of manufacturer's written instructions for recommended maintenance practices for each type of resilient flooring and accessories.

1.05 JOB CONDITIONS:

A. Continuously heat areas to receive flooring to 70 degrees F. for at least 48 hours prior to installation, when project conditions are such that heating is required. Maintain 70 degrees F. temperature continuously during and after installation, as recommended by flooring manufacturer, but for not less than 48 hours.

1.06 EXTRA STOCK

A. Deliver to the Owner, for his use in future modifications, an extra stock of approximately 10% of each color and pattern in each material installed under this Section, packaging each type of material separately, distinctly marked, and adequately protected against deterioration.

PART 2 – PRODUCTS

2.01 TILE FLOORING:

A. Vinyl Composition Tile: ASTM F-1066-95a CLASS 2 through pattern, 12" x 12" x 1/8" gage.

1. Armstrong, Standard Excelon – Imperial Texture, thru-chip floor tile.

   a. Color: TBD – Note: Multiple colors and patterns will be used in each room/area.
2.02 ACCESSORIES:

A. Resilient Base:

1. Provide resilient base complying with ASTM F1861, Type TS, rubber as follows:
   a. Height: 4” refer to drawings for locations.
   b. Thickness: 1/8” gage.
   c. Style: Standard top-set cove.
   d. Roll length: Not less than 100 feet.
   e. Manufacturer: Johnsonite
   f. Color: TBD

B. Resilient stair one piece nosing-tread-riser and landing surface. Furnish product consisting of single piece units for width of stair nosing-tread-riser.

1. Provide rubber stair nosing-tread-riser units equal to:
   Johnsonite: Visually impaired one-piece tread/riser (virtr) raised profile rubber stair tread. Color selected by Architect from manufacturer’s standard colors. Provide with square raised profile.
2. Provide matching landings component to tread/riser piece.
3. Install per manufacturers specification to maintain warranty.

C. Resilient Moulding/Reducer/Floor Finishing Accessories:

1. Provide vinyl carpet edge guards for glue down applications, nosings for resilient floor covering reducer strip for resilient floor covering, adaptor at junction between two dissimilar materials (new/new or new/existing), where shown on drawings and/or required.

   a. Provide accessories as manufactured by Johnsonite as follows:
      1. Carpet to VCT: Johnsonite CTX-XX-D 5/16” to 1/8” (adaptor)
      2. VCT to Sealed Concrete: Johnsonite RRS-XX-C 1/8” to floor (reducer)
3. Carpet to Rubber Flooring: Johnsonite CTX-XX-D 5/16” to 1/8” (adaptor)
4. Porcelain Ceramic Tile to Rubber Flooring: Johnsonite CTA-XX-K 3/8” to 1/8” (wheeled traffic transition)
5. Porcelain ceramic tile to painted concrete: Johnsonite CRS-XX-B 3/8” to floor (reducer)
6. Carpet to Porcelain Tile: TO BE DETERMINED

b. Color to be selected by Architect from manufacturer’s standard colors.

c. Install per manufacturer’s standard specifications to maintain warranty.

D. Adhesives (cements): As recommended by flooring contractor to suit material and substrate conditions.

E. Concrete Slab Primer: Non-staining type as recommended by flooring manufacturer.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Installer must examine the areas and conditions under which resilient flooring and accessories are to be installed and notify the General Contractor, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 PREPARATION:

A. Prior to laying flooring, broom clean or vacuum surfaces to be covered and inspect subfloor. Start of flooring installation indicates acceptance of subfloor conditions and full responsibility for completed work.

1. Use leveling compound as recommended by flooring manufacturer for filling small cracks and depressions in subfloors.

2. Perform moisture tests on concrete slabs to determine that concrete surfaces are sufficiently cured and ready to receive flooring.
3. Apply concrete slab primer, if recommended by flooring manufacturer, prior to application of adhesive. Apply in compliance with manufacturer's directions.

3.03 INSTALLATION:

A. General:

1. Install flooring after finishing operations, including painting, have been completed and permanent heating system is operating. Moisture content of concrete slabs, building air temperature, and relative humidity must be within limits recommended by flooring manufacturer.

2. Place flooring with adhesive cement in strict compliance with manufacturer's recommendations. Butt tightly to vertical surfaces, thresholds, nosing and edgings. Scribe around obstructions and produce neat joints, laid tight, even and straight. Extend flooring into toe spaces, door reveals and into closets and similar openings.

3. Maintain reference markers, holes or openings that are in place or plainly marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other non-permanent marking device.

4. Maintain overall continuity of color and pattern with pieces of flooring installed in these covers. Tightly cement edges to perimeter of floor around covers and to covers.

5. Tightly cement flooring to subbase without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks or other surface imperfections.

B. Tile Floors:

1. Lay tile from center marks established with principal walls, discounting minor offsets, so that tile at opposite edges of the room are of equal width. Adjust as necessary to avoid use of cut widths less than 1/2 tile at room perimeters. Lay tile square to room axis, unless otherwise shown.

2. Match tiles for color and pattern by using tile from cartons in same sequence as manufactured and packaged. Cut tile neatly to around all fixtures. Broken, cracked, chipped or deformed tile are not acceptable.
C. Accessories:

1. Apply resilient base to walls, columns, pilasters, casework and other permanent fixtures in rooms or areas where base is required. Install base in as long lengths as practicable, with preformed corner units or fabricated from base materials with mitered or coped inside corners. Tightly bond base to backing throughout the length of each piece, with continuous contact at horizontal and vertical surfaces.
   a. On masonry surfaces or other similar irregular surfaces, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.

2. Place resilient edge strips tightly butted to flooring and secure with adhesive. Install edging strips at all unprotected edges of flooring, unless otherwise shown.

3.04 CLEANING AND PROTECTION:

A. Remove any excess adhesive or other surface blemishes, using neutral type cleaners as recommended by flooring manufacturer. Protect installed flooring from damage by covering.

B. Finishing: After completion of project and just prior to final inspection of work, thoroughly clean floors and accessories.

C. Apply wax and buff with type of wax, number of coats and buffing procedures, in compliance with flooring manufacturer's instructions.
SECTION 09680 – CARPETING

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes
   1. Carpet Squares (Modular carpet)
   2. 6’ roll goods (Broadloom)

B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this Section.

1.02 SUBMITTALS

A. Shop Drawings showing the extent of carpet, installation pattern of carpet, and accessories shall be submitted to Architect for approval prior to installation. Check pattern match, if any, for matching during installation and possible waste factors in ordering required amounts. Should also indicate columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet. Copy of approved shop drawings to be available on job site during installation.

B. Carpet schedule using same room designations indicated on drawings.

C. Product Data: Provide data on specified products, describing physical and performance characteristics, sizes, patterns, colors available, and method of installation.

D. Selection Samples: Submit manufacturer’s complete set of color samples for Architect’s initial color selection.

E. Verification Samples: Submit two 18” x 18” samples illustrating color and pattern for each carpet material specified.

F. Manufacturer’s Installation Instructions: Indicate special procedures and perimeter conditions requiring special attention.
G. Maintenance Data: Include maintenance procedures, recommendations for maintenance materials and equipment, and suggested schedule for cleaning.

H. Manufacturer’s Carpet Warranty.

I. Certification of Recycled Content and verification of reclamation and recycling program.

J. Certifications: Manufacturer to submit copies of the following independent laboratory reports showing compliance with requirements per these methods outlined in Part 2 of this document. Submitted results shall represent average results for production goods of the specified style.

1. ASTM E-648 Flooring Radiant Panel - Class 1 (mean avg CRF: 0.45w/sq cm or higher
2. ASTM E-662: Smoke Density
3. AATCC 134: Electrostatic Propensity - 3.0 kv or lower-permanent conductive fiber
4. CRI TM-102: Fluorine Analysis - min 500 ppm after two AATCC 171: min. 400 ppm
5. ASTM D-3936: Delamination

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications
1. Company specializing in manufacturing specified carpet with minimum 10 years documented experience.

2. Upon request, manufacturer to provide representative to assist in project start-up and to inspect installation while in process and upon completion. Representative will notify designated contact if any installation instructions are not followed.

3. Single Source Responsibility: Obtain each type of carpet from one source and by a single manufacturer.

B. Installer Qualifications

1. Flooring contractor must be certified by the carpet manufacturer prior to bid.
2. Flooring contractor to be a specialty contractor normally engaged in this type of work and shall have prior
experience in the installation of these types of materials.

3. Flooring contractor possessing Contract for the carpet installation shall not sub-contract the labor without written approval of the Project Manager.

4. Flooring contractor will be responsible for proper product installation, including floor testing and preparation as specified by the carpet manufacturer and JOB CONDITIONS herein.

5. Flooring contractor to provide Owner a written installation warranty that guarantees the completed installation to be free from defects in materials and workmanship for a period of one year after job completion.

1.04 DELIVERY, STORAGE, & HANDLING

A. Deliver materials to the site in manufacturer’s original packaging listing manufacturer’s name, product name, identification number, and related information.

B. Store in a dry location, between 60 degrees F and 80 degrees F and a relative humidity below 65%. Protect from damage and soiling. Stack carpet rolls horizontally on a flat surface, stacked no higher than two rolls.

C. Make stored materials available for inspection by the Owner’s representative.

D. Store materials in area of installation for minimum period of 48 hours prior to installation.

1.05 PROJECT CONDITIONS

A. Sub-floor preparation is to include all required work to prepare the existing floor for installation of the product as specified in this document and Manufacturer’s installation instructions.

B. The maximum amount of moisture evacuation from the floor is 5.0 pounds per 1,000 square feet in 24 hours per ASTM F-1869.04. The acceptable pH level of the substrate is 9.0 or
less as tested per ASTM F-710.05. Flooring contractor is responsible for floor testing. Contractor shall perform min. (1) MVER and 2 RH be performed on the initial 1,000 s.f. for each project and one test between MVER & RH for each 1,000 s.f. for balance of project at each location/floor.

C. All material used in sub-floor preparation and repair shall be recommended by the carpet manufacturer and shall be chemically and physically compatible with the carpet system being bid.

D. Maintain minimum 65 degrees F ambient temperature and 65% Relative Humidity for 72 hours prior to, during, and 48 hours after installation.

E. Do not install carpet until space is enclosed and weatherproof, wet-work in space is completed and nominally dry, work above ceilings is complete, and ambient temperature and humidity conditions are and will be continuously maintained at values near those indicated for final occupancy.

1.06 EXTRA MATERIALS

A. Provide additional 5% of each product per floor for attic stock.

PART 2 - PRODUCTS

2.01 PRODUCT RECYCLABILITY

A. Product must meet FTC guides for recyclability and must be one hundred percent (100%) closed-loop recyclable back into carpet. Products containing both recyclable and non-recyclable components, manufacturer must adequately report which portions of the product are recyclable per FTC guides 16 CFR section 260.7(d). Note: A manufacturer cannot claim that a product or any portion of a product that is incinerated is recyclable, even if incineration is used to produce heat and power (i.e. waste-to-energy) per FTC guides 16 CFR section 260.7 (d) example 3.
B. Recyclability of product installed must be the same as that claimed by manufacturer and required by Project requirements.

2.02 RECYCLING PROGRAM

A. Manufacturer must have a collection and recovery system for product and a fully established, currently operational recycling program at time of bid per FTC guides Section 260.7 (d).

B. Manufacturer must be able to reclaim and recycle 100% of existing carpet of similar composition back into carpet at time of bid.

C. Manufacturer must have product a take back program and be able to reclaim and recycle 100% of installed product back into carpet at the end of its service life at time of bid. Claiming a product is recyclable based on future expectation of technology, equipment, process or availability of that product as feed stock is not acceptable. Recycling process must be available for viewing.

D. Collection and recycling program must be verified by an independent, neutral third-party organization, such as Scientific Certification Systems.

E. Manufacturer must have written guarantee that 100% of the recovered product will be recycled and that no portion of the product will be landfilled or incinerated (including waste-to-energy).

2.03 MANUFACTURER’S ENVIRONMENTAL COMMITMENT

A. A manufacturer's environmental commitment will be reflected by its corporate culture and measured by the goals, policies and programs that have been instituted to improve the environmental performance of its operations. Evidence of this commitment must include:

1. All products produced by the manufacturer must meet FTC guides for recyclability and be 100% recyclable in a fully established, currently operational recycling program 16 CFR section 260.7 (d).
2. All products produced by the manufacturer, including recycled content products, must be 100% closed-loop recyclable back into carpet.

3. Manufacturer must show evidence of a positive and continuing improvement in source reduction and the reduction of energy, water, waste and air emissions.

4. Manufacturer must fully comply with FTC Part 260 “Guides for the Use of Environmental Marketing Claims,” with respect to advertising, labeling, product inserts, catalogs and sales presentations of all its carpet products submitted and sold. Certification signed by an officer of the manufacturer stating the manufacturer complies with these guides maybe required for submittal upon request.

2.04 INDOOR AIR QUALITY

A. Product must have low VOC, factory applied, “dry” adhesive.

B. Product, inclusive of floor covering adhesive, must meet CRI’s IAQ requirements for carpet only. Environmental chamber testing per ASTM D-5116. Emission Rates determined at 24 hours. Product, inclusive of pre-applied adhesive must off gas less than:

- 0.5 mg/sq. meter per hour of Total Volatile Organic Compound (TVOC);
- 0.05 mg/sq. meter per hour of formaldehyde;
- 0.4 mg/sq. meter per hour of styrene; and
- 0.05 mg/sq. meter per hour of 4-Phenyl Cyclohexene (4-PC)

1. Submit Indoor Air Quality report showing CRI Green label Certification Number for carpet (inclusive of adhesive). [If results for carpet testing are not inclusive of adhesive, submit separate IAQ test reports for carpet and adhesive].

2. Indoor air quality results of the product installed must be same as those specified by the Project requirements.
3. Additionally, product, inclusive of adhesive, must meet the requirements of the State of Washington Indoor Air Quality Specifications for Carpet at 24 hours. Environmental chamber testing per ASTM D-5116. Product must not require the 30-day air out period that the State of Washington protocol allows.

2.05 CARPET WARRANTY

A. Warranty to be sole source responsibility of the Manufacturer. Second source warranties and warranties that involve parties other than the carpet manufacturer are unacceptable.

B. If the product fails to perform as warranted when properly installed and maintained, the affected area will be repaired or replaced at the discretion of the Manufacturer.

C. Chair pads are not required, but are recommended for optimum textural performance. Absent the use of chair pads, more intensive maintenance will be required for areas in direct contact with chair caster traffic, and some degree of appearance change is to be expected.

D. Warranty shall be for a specifically defined non-prorated period of (25) twenty-five years. "Lifetime" warranties are not acceptable. More intensive maintenance will be required for product installed on stairs, and some degree of appearance change is to be expected.

E. Warranty shall not exclude carpet product installed on stairs provided it is properly installed and maintained.

F. The non-prorated (25) twenty-five years warranty shall specifically warrant against:
   1. Excessive Surface Wear: More than 15% loss of pile fiber weight
   2. Excessive Static Electricity: More than 3.0 kV per AATCC 134
   3. Resiliency Loss of the Backing: More than 10% loss of backing resiliency
   4. Delamination
   5. Edge Ravel
   6. Zippering
G. Tuft Bind warranty in lieu of edge ravel and zippering is not acceptable.

2.06 FIBER

A. Nylon Fiber: Solution Dyed, Bulked Continuous Filament (BCF) Nylon Bulked Continuous Filament (BCF) Nylon in a loop pile construction. Cut pile is not acceptable.

B. Report fiber type (i.e. EPP Certified Invista Antron, SAVANT, etc.)

C. Report post consumer and post industrial recycled content of the pile face yarn in product based on weight i.e. \[
\left( \frac{\text{Recycle Content in Pile Face Yarn}}{\text{Total Weight of Pile Face Yarn}} \right) \times 100
\]

D. Fiber to contain carbon-core filament for permanent static control. Topical treatments are not acceptable.

E. Durable stain inhibitor should be applied to the fiber during product manufacturing to resist fiber staining and soiling.
   1. Initial: Minimum 500 ppm Fluorine per CRI TM-102
   2. After two hot water extractions per AATCC 171: Minimum 400 ppm Fluorine per CRI TM-102

2.07 BACKING CHARACTERISTICS

A. Primary Backing: Synthetic Non-Woven.

B. Secondary Backing: ER3 100% recycled content
   1. Density (ASTM D-1667): Min. 65 lbs/cu ft +/- 5%
   2. Standard Size: 24” x 24”
   3. Recycled content: 100% recycled content secondary backing.
   4. Fiberglass reinforced.
   5. Face yarn fully fused to secondary backing system that will not delaminate.
   7. Product must not contain pesticides (US EPA registered antimicrobials). Installation adhesives are exempt from this section.

C. Adhesive System: RS
1. Low VOC, factory applied “dry” adhesive applied to backing and cured during manufacturing
2. Product as installed to be securely attached to the floor in compliance with Americans with Disabilities Act (ADA), Section 4.5.3.

D. Product to provide asbestos enclosure properties. Enclosure means an airtight, impermeable, permanent barrier around ACBM (Asbestos Containing Building Material) to prevent the release of asbestos fibers into the air.

2.08 PERFORMANCE CHARACTERISTICS

A. Test reports for the following performance assurance testing to be submitted upon request. Submitted results shall represent average results for production goods of the referenced style. Requirements listed below must be met by all products.

1. Flooring Radiant Panel
   ASTM E-648 / NFPA 253: Class 1 (CRF: 0.45 watts/sq cm or greater)

2. Federal Flammability
   CPSC FF 1-70: Passes

3. Smoke Density
   ASTM E-662 / NFPA 258: ≤ 450 Flaming Mode

4. Electrostatic Propensity
   AATCC 134 (Step & Scuff): 3.0 kV or less

5. Static Coefficient of Friction
   ASTM C-1028: Passes ADA Requirements for Accessible Routes (minimum 0.60)

6. Delamination of Secondary Backing of Pile Floor Coverings
   ASTM D-3936: No Delamination

7. Lightfastness
   AATCC 16E: ≥ 4 @ 100 hours

8. TARR
   3.0 minimum

9. Dimension Stability
   AACHEN/ISO 2551: maximum change =/− 0.149%
10. Other
  As specified in 2.06 and 2.07 of this document

2.09 MANUFACTURING SPECIFICATIONS

A. Manufactured by C&A Floorcoverings (Contact: Paul Brown, Cell: pbrown@tandus.com)

1. Offices: Individual offices, open offices, conference rooms, office corridors and any other room scheduled for carpet not indicated elsewhere in this Spec. Transfer (style #03366) 24” x 24” modular flex aire cushion. Multiple colors to be selected.
   a. Construction: Stratatec patterned loop
   b. Gauge: 5/64
   c. Stitches per inch: 10.0
   d. Pile Height Average: 0.187 inch
   e. Fiber System: Dynex SD nylon with Static Control and Ensure.
   f. Dye Method: 100% solution dyed
   g. Face Weight: 19 oz/sq yd
   h. Product installation: 24” x 24” unidirectional modular installation

2. Court Rooms: Shaw Contract, Jasper Tile
   a. Construction: Multi-level pattern loop
   b. Gauge: 1/12 inch
   c. Stitches per inch: 10.0
   d. Fiber System: Eco Solution Q Nylon
   e. Dye Method: 93% solution dyed/7% yarn dyed
   g. Tufted Weight: 22 oz/sq yd
   h. Product installation: Tile with synthetic backing

2.10 ACCESSORIES

A. Materials recommended by Manufacturer for patching, priming, seam welding, etc.

B. Adhesives: Products to be supplied with a low VOC, factory applied, “dry” adhesive for “peel and stick” installation.
C. Base, Carpet Edge, and Transition Strips: As specified in applicable sections.

PART 3 EXECUTION

3.01 EXAMINATION / PREPARATION

A. Prepare sub-floor to comply with criteria established in Manufacturer’s installation instructions. Use only preparation materials that are acceptable to the Manufacturer.

1. Remove all deleterious substances from substrate(s) that would interfere with or be harmful to the installation (i.e. floor wax).
2. Remove sub-floor ridges and bumps. Fill cracks, joints, holes, and other defects.

B. Verify that sub-floor is smooth and flat within specified tolerances and ready to receive carpet.

C. Verify that substrate surface is dust-free and free of substances that would impair bonding of product to the floor.

D. Verify that concrete surfaces are ready for installation by conducting moisture and pH testing. Results must be within limits recommended by Manufacturer.

E. There will be no exceptions to the provisions stated in the Manufacturer’s installation instructions.

3.02 INSTALLATION - GENERAL

A. Install product in accordance with Manufacturer’s installation instructions.

B. Verify carpet match before cutting to ensure minimal variation between dye lots.

C. Layout carpet in accordance with shop drawings.

D. Install carpet tight and flat on sub-floor, well-fastened at edges, with a uniform appearance.
E. Roll with appropriate roller for complete contact of carpet with mill-applied adhesive to sub-floor.

F. Trim carpet neatly at walls and around interruptions.

G. Completed carpet is to be smooth and free of bubbles, puckers, and other defects.

3.03 PROTECTION & CLEANING

A. Remove excess adhesive and from floor and wall surfaces without damage.

B. All rubbish, wrappings, debris, trimmings, etc. to be removed from site and recycled or disposed of properly.

C. Clean and vacuum carpet surfaces using a beater brush/bar commercial vacuum.

D. After each area of carpet is installed, protect from soiling and damage by other trades.

END OF SECTION 09680
SECTION 09830 – ELASTOMERIC COATINGS

Part 1 - General

1.1 Summary

A. This specification describes the coating of substrates with an elastomeric, crack bridging, anti-carbonation, protective coating.

B. Related work specified elsewhere:
1. Section 03300 – Bonding Agents for Concrete
2. Section 07910 – Joint Fillers & Gaskets
3. Section 07920 – Sealants & Caulking

1.2 Quality Assurance

A. Manufacturing qualifications: The manufacturer of the specified product shall be ISO 9001:2008 certified and have in existence a recognized ongoing quality assurance independently audited on a regular basis.

B. Contractor qualifications: Contractor shall be qualified in the field of concrete repair and protection with a successful track record of 5 years or more. Contractor shall maintain qualified personnel who have received product training by a manufacturer's representative.

C. Install materials in accordance with all safety and weather conditions required by manufacturer or as modified by applicable rules and regulations of local, state and federal authorities having jurisdiction. Consult Material Safety Data Sheets for complete handling recommendations.

1.3 Delivery, Storage, and Handling

A. All materials must be delivered in original, unopened containers with the manufacturer's name, labels, product identification, and batch numbers. Damaged material must be removed from the site immediately.

B. Store all materials off the ground and protect from rain, freezing or excessive heat until ready for use.

C. Condition the specified product as recommended by the manufacturer.
1.4 Job Conditions

A. Environmental Conditions: Do not apply material if it is raining or snowing or if such conditions appear to be imminent. Minimum application temperature 45°F (7°C) and rising.

B. Protection: Precautions should be taken to avoid damage to any surface near the work zone due to mixing and handling of the specified material.

1.5 Submittals

A. Submit five copies of manufacturer's literature, to include: Product Data Sheets, and appropriate Material Safety Data Sheets (MSDS).

1.6 Warranty

A. Provide a written warranty from the manufacturer against defects of materials for a period of one (1) year, beginning with date of substantial completion of the project.

Part 2 - Products

2.1 Manufacturer

A. Sikagard 550W Elastocolor, (2) coat system as manufactured by Sika Corporation, 1682 Marion Williamsport Road, Marion, Ohio, 43302 is considered to conform to the requirements of this specification.

B. BASF – Masterprotect HB400 (Thorocoat) (2) coat system.

2.2 Materials

A. Elastomeric Acrylic Coating: (based on Sikagard 550W)

1. Product shall be 100% Acrylic Emulsion with the following properties:
   a. Water vapor permeable
   b. Can bridge dynamically moving cracks
   c. Crack bridging properties maintained at low temperatures.
   d. The material shall be resistant to dirt pick-up and mildew

ELASTOMERIC COATINGS
2.3 Performance Criteria

A. Properties of the elastomeric Sikagard 550W Elastocolor acrylic coating:

1. Pot Life: indefinite

2. Tack Free Time 6 Hours @ 73°F, 50% Relative Humidity. Final Cure < 24 Hours

3. Carbon Dioxide Diffusion: µCO₂ 214,000 Carbon Dioxide Diffusion Resistance at 16 mils (400 microns) SdCO₂ = 299 ft. (equivalent air thickness) i.e. Approx. 9-in. of standard concrete cover.

4. Water Vapor Diffusion: µH₂O 2,146 Water Vapor Diffusion Resistance at 16 mils SdH₂O = 2.6 ft. (0.8m) (equivalent air thickness)

5. Moisture Vapor permeability (ASTM E96) 14.5 perms

6. Tensile Properties (ASTM D-412 Modified)
   7 day-Tensile strength 190 psi (1.3 MPa) - Elongation at break 820% - 340% @ 0°F (-18°C)

7. Crack Bridging (at 16 mils = 400 microns DFT
   a. Static (at -4°F/-20°C) 30 mils (0.75mm)
   b. Dynamic>1000 cycles (at -4°F/-20°C) 12 mils (0.30mm)

8. Resistance to wind driven rain (TT-C-555B): No passage of water through coating

9. Weathering (ASTM G-23) 10,000 hours excellent, no chalking or cracking.

10. Solids Content: by weight - 62% by volume - 55%

11. Flame Spread and Smoke Development (ASTM E-84-94)

   Flame Spread 5   Smoke Development 5   Class Rating A

Note: Tests above were performed with the material and curing conditions @ 71°F - 75°F and 45-55% relative humidity.
Part 3 – Execution

3.1 Surface Preparation

A. Substrate must be clean, sound, and free of surface contaminants. Remove dust, laitance, grease, oils, curing compounds, form release agents and all foreign particles by mechanical means. Substrate shall be in accordance with ICRI Guideline No. 03732 for coatings and fall within CSP1 to CSP3.

3.2 Mixing and Application

A. Mixing: Stir materials to ensure uniformity using a low speed (400-600 rpm) drill and paddle. To minimize color variation, blend two batches of material. (boxing)

B. Crack detail: Recommended application temperatures 40°F - 100°F (4°C - 38°C)

Small defects and cracks (non-structural): Cracks 10 – 20 mils. Apply Surface Filler “Brush Grade” generously over the center of the cracks. Feather material to zero over a two-inch wide area. Allow a minimum 24 hours to cure before overcoating.

Large defects and cracks (non-structural): Cracks >20mils. Rout to 1/4-in wide by 1/4-in deep. Blow out cut with oil-free compressed air. Fill slot with Surface Filler “Knife Grade” allowing for a small crest to remain. This will compensate for any shrinkage that might occur. NOTE: Sikaflex-1a,-2c, or -15LM, polyurethane sealant may be used in place of Knife Grade Surface Filler. Allow 24 hours minimum cure before overcoating.

C. Coating Application: Apply by brush, roller, or spray over entire area moving in one direction. A minimum of two coats are required. Each coat should be applied at a rate not to exceed 100 sq. ft. per gallon. Total dry film thickness shall be a minimum 8 – 10 dry mils per coat. Allow a minimum of 2 hours prior to re-coating.

D. When applying the coating, never stop the application until the entire surface has been coated. Always stop application at an edge, corner, or joint. Never let a previously coated film dry; always coat into a wet film. Always apply the coating at a 45° angle to an edge, corner, or joint.
E. If substrate has been previously coated and presents a “chalky” condition, apply 1 coat of Sikagard 552W or SikaLatex R, primer/surface conditioner by brush, roller, or spray at a rate not to exceed 300 sq. ft. per gallon.

F. Adhere to all limitations and cautions for the elastomeric acrylic coating in the manufacturers printed literature.

3.3 Cleaning

A. The uncured elastomeric acrylic coating can be cleaned from tools with water. The cured elastomeric acrylic coating can only be removed mechanically.

B. Leave finished work and work area in a neat, clean condition without evidence of spills or overspray onto adjacent areas.

END OF SECTION
PART 1 – GENERAL

1.01  RELATED DOCUMENTS:
   A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02  DESCRIPTION OF WORK:
   A. The extent of painting work is shown on the drawings and schedules, and as herein specified. Note: Multiple colors, both field and accent colors will be used at each area or space.
      1. Coating systems for interior masonry walls, holding cells, interior steel (metal doors, HM frames, stair stringers, guardrails, balusters, steel walkways, ladders, grilles, etc.). Note: Multiple colors will be used in individual areas. Refer to Spec Section 09970 High Performance Coatings.
   B. The work includes painting and finishing of interior exposed items and surfaces throughout the project, except as otherwise indicated.
   C. The work includes field painting of exposed bare and covered pipe and ducts (excluding color coding), and of hangers, exposed steel and iron work, and primed metal surfaces of equipment installed under the mechanical and electrical work, except as otherwise indicated.
   D. Surface preparation, priming and coats of paint specified are in addition to shop-priming and surface treatment specified under other sections of work.
   E. "Paint" as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers and other applied materials, whether used as prime, intermediate or finish coats.
F. Paint all exposed surfaces in areas designated "paint" in "schedules," except where the natural finish of the material is specifically noted as a surface not to be painted. Where items or surfaces are not specifically mentioned, paint them the same as adjacent similar materials or areas.

1.03 PAINTING NOT INCLUDED:

A. The following categories of work are not included as part of the field-applied finish work, or are included in other sections of these specifications:

1. Shop Priming: Unless otherwise specified, shop priming of ferrous metal items is included under the various sections for structural steel, miscellaneous metal, hollow metal work, and similar items.

2. Pre-Finished Items: Unless otherwise indicated, do not include painting when factory-finishing or installer finishing is specified for such items as (but not limited to) metal toilet enclosures, acoustic materials, casework, finished mechanical and electrical equipment including light fixtures, switchgear and distribution cabinets, but not light or power panels where exposed elevator entrance frames, doors and equipment.

3. Concealed surfaces: Unless otherwise indicated, painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, foundation spaces, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.

4. Finished Metal Surfaces: Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, unless otherwise indicated.

5. Operating Parts and Labels:
   a. Moving parts of operating units, mechanical and electrical parts such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting unless otherwise indicated.
b. Do not paint over any code-required labels, such as Underwriters', Laboratories and Factory Mutual, or any equipment identification, performance rating, name or nomenclature plates.

1.04 SUBMITTALS:

A. Product Data:

1. For information only, submit 2 copies of manufacturer's technical information including paint label analysis and application instructions for each materials proposed for use. Transmit a copy of each manufacturer's instructions to the paint Applicator.

B. Samples:

1. Submit samples for Architect's review of color and texture only. Compliance with all other requirement is the Exclusive responsibility of the Contractor. Provide a listing of the materials and application for each coat of each finish sample.

   a. On 12" x 12" hardboard, provide two samples of each color and material with texture to simulate actual conditions. Resubmit each samples as requested until acceptable sheen, color and texture is achieved.

   b. On actual wood surfaces, provide two 4" x 8" samples of each stained wood finish as required. Label and identify each as to location and application.

1.05 DELIVERY AND STORAGE:

A. Deliver all materials to the job site in original, new and unopened packages and containers bearing manufacturer's name and label, and the following information:

1. Name or title of material.

2. Fed. Spec. Number, if applicable.

3. Manufacturer's stock number and date of manufacturer.
4. Manufacturer's name.

5. Contents by volume, for major pigment and vehicle.


7. Thinning instructions.

8. Application instructions.

9. Color name and number.

1.06 JOB CONDITIONS:

A. Apply water-base paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 50 degrees F. and 90 degrees F., unless otherwise permitted by the paint manufacturer's printed instructions.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and the surrounding air temperatures are between 45 degrees F. and 95 degrees F. unless otherwise permitted by the paint manufacturer's printed instructions.

C. Do not apply paint in snow, rain, fog or mist; or when the relative humidity exceed 85% or to damp or wet surfaces; unless otherwise permitted by the paint manufacturer's printed instructions.

1. Painting may be continued during inclement weather only if the areas and surfaces to be painted are enclosed and heated within the temperature limits specified by the paint manufacturer during application and drying periods.

PART 2 – PRODUCTS

2.01 COLORS AND FINISHES:

A. Prior to beginning work, the Architect will furnish color selections for surfaces to be painted. Colors will vary from wall to ceiling and from room to room. Final selection for gloss level will be by Architect and may not necessarily be the same as scheduled.
1. Use representative colors when preparing samples for review.
2. Final acceptance of colors will be from samples applied on the job.

B. Color Pigments: Pure, non-fading, applicable types to suite the substrates and service indicated.

C. Paint Coordination: Provide finish coats which are compatible with prime paints used. Review other sections of these specifications in which prime paints are to be provided to ensure compatibility of total coatings system for various substrates. Upon request from other trades, furnish information on characteristics of finish materials proposed for use, to ensure compatible prime coats are used. Provide barrier coats over incompatible primers or remove and reprime as required. Notify the Architect in writing of any anticipated problems using specified coating systems with substrates primed by others.

2.02 INTERIOR PAINTING SCHEDULE:

A. Concrete Masonry Surfaces (Semi-Gloss) (Vinyl Acrylic Latex System)

1. Primer: Vinyl Acrylic Block Filler
   PPG: Aquapon7 WB Polyamide-Epoxy #98-Line Series
   Standard: A-7012 Interior/Exterior Latex Block Filler

2. Finish Coats: Vinyl Acrylic Semi-Gloss Enamel (25-35 units at 60 degrees F.), 1.5 DFT/coat.
   PPG: (1 coat) Aquapon7 WB Polyamide-Epoxy #98-Line Series
   Standard: A-7010 Stanaglo Latex Semi-Gloss

B. Concrete Masonry Surfaces (Semi-Gloss): (Water Based Epoxy - Normal Exposure)

1. Primer: 100 percent Acrylic Resin Block Filler, .075 - 1.0 DFT/coat.
   S-W: Heavy Duty Block Filler, B42W46.
   PPG: Speedhide7 Latex Masonry Block Filler #6-7
   Standard: A-7012 Interior/Exterior Latex Block Filler
2. Finish Coats: Water Based Epoxy, Semi-Gloss (20-30 units at 60 degrees F.) 3 mils DFT/coat.
   **S-W:** (2 coats) Water Based Catalyzed Epoxy, B70/B60V25.
   **PPG:** (2 coats) Pitt-Glaze7 High Solids Semi-Gloss Acrylic-Epoxy #16-900 Series
   **Standard:** (2 coats) Hydro-Glaze Water Based Epoxy

C. Metal-Ferrous (Semi-Gloss): (Alkyd Enamel System, Maximum VOC content 450 grams/liter)

   1. Primer: Modified Alkyd Resin Primer, 3 mils DFT/coat
      **S-W:** Kem Kromik Universal Metal Primer, B50Z
      **PPG:** Speedhide7 Inhibitive Primer #6-208 red or #6-212 white
      **Standard:** Hydro-Prime
   2. Finish Coats: Alkyd Enamel, Semi-Gloss (40-50 units at 60 degrees F.) 3.0 mils DFT/coat.
      **S-W:** (2 coats) Alkyd Enamel, Semi-Gloss B34W200.
      **PPG:** (2 coats) Speedhide7 Alkyd Semi-Gloss #6-1110 Series
      **Standard:** A-7067 Workrite Vinyl Acrylic Semi-Gloss

D. Metal - Galvanized (Semi-gloss): **Code #5.13** (Acrylic Latex System)

   1. Finish Coats: 100 percent Acrylic, Waterborne, Semi-Gloss (30-40 units at 60 degrees F.) 3.0 mils DFT/coat.
      **S-W:** (2 coats) DTM Acrylic coating, B66W200.
      **PPG:** (2 coats) Pitt-TechJ Open Pack DTM Waterborne Satin Enamel #90-474 Series
      **Standard:** A-7010 Stanoglo Semi-Gloss Enamel

E. Gypsum Board (Flat): (Acrylic Latex System)

   1. Primer: Vinyl Acrylic Latex, 1.1 mils DFT/coat
      **S-W:** ProMar 200 Latex Wall Primer, B28W200.
      **PPG:** Speedhide7 Latex Primer-Sealer #6-2
      **Standard:** A-7013 Vinyl Primer
   2. Finish Coats: Vinyl Acrylic Flat (0-5 units at 90 degrees F.), 1.4 mils DFT/coat.
      **S-W:** (2 coats) ProMar 200 Latex Flat Wall Paint, B30W200.
      **PPG:** (2 coats) Speedhide7 Acrylic Latex Flat Wall Paint #6-70 Series
      **Standard:** A-7017 Walplex Flat Latex
F. Gypsum Board (Semi-Gloss): (Acrylic Latex System)

1. Primer: Vinyl Acrylic Latex, 1.1 mils DFT/coat
   PPG: Speedhide7 Latex Primer-Sealer #6-2
   Standard: A-7013 Vinyl Primer

2. Finish Coats: Vinyl Acrylic Semi-Gloss (25-35 units at 60 degrees F.), 1.5 mils DFT/coat.
   PPG: (2 coats) Speedhide7 Acrylic Latex Semi-Gloss Enamel #6-510 Series
   Standard: A-7010 Stanoglo Semi-Gloss Enamel

G. Gypsum Board (Semi-Gloss): (Water Based Epoxy System)

1. Primer: Vinyl Acrylic Latex, 1.1 mils DFT/coat
   PPG: Speedhide7 Latex Primer-Sealer #6-2
   Standard: A-7013 Vinyl Primer

2. Finish Coats: Water Based Catalyzed Epoxy, Semi-Gloss (20-30 units at 60 degrees F.), 2.5 - 3.0 mils DFT/coat.
   S-W: (2 coats) Water Based Catalyzed Epoxy, P60V25.
   PPG: (2 coats) Pitt-Glaze 7 High Solids Semi-Gloss Acrylic-Epoxy #16-900 Series
   Standard: Hydro-Glaze Water Borne Epoxy

H. Painted Woodwork:

   Two Coats of Interior Semi-Gloss Alkyd Enamel Over an alkyd Undercoater.

   1. PPG Paints; 17-956 PPG Seal Grip® Interior Alkyd Enamel Undercoater
   2. PPG Paints; 6-1110XI SPEEDHIDE Interior Wall and Trim Semi-Gloss Oil
I. Stained Woodwork:

Two Coats of Semi-Gloss Oil Polyurethane over an Oil based Stain and One Coat of Sanding Sealer.

1. PPG Paints; OLYMPIC 41570 Premium Interior Fast Dry Wood Stain Oil Based
2. PPG Paints; Deft DFT60 Interior Oil Based Sanding Sealer
3. PPG Paints; Deft DFT224 Interior Semi-Gloss Oil Polyurethane

PART 3 - EXECUTION

3.01 INSPECTION:

A. Applicator must examine the areas and conditions under which painting work is to be applied and notify the General Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Applicator.

B. Starting of painting work will be construed as the Applicator's acceptance of the surfaces and conditions within any particular area.

C. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film.

3.02 SURFACE PREPARATION:

A. General:

1. Perform preparation and cleaning procedure in strict accordance with the paint manufacturer's instructions and as herein specified for each particular substrate condition.

2. Remove all hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be finish-painted, or provide surface-applied protection prior to surface preparation and painting operations. Remove, if necessary for the complete painting of the items and adjacent surfaces. Following completion of painting of each space or area, reinstall the removed items by workmen skilled in the trades involved.
3. Clean surfaces to be painted before applying paint or surface treatments. Remove oil and grease prior to mechanical cleaning. Program the cleaning and painting so that contaminants from the cleaning process will not fall onto wet, newly-painted surfaces.

B. Cementitious Materials:

1. Prepare cementitious surfaces to be painted by removing all efflorescence, chalk, dust, grease, oils, and by roughening as required to remove glaze, conforming to SSPC13.

2. Determine the alkalinity and moisture content of the surfaces to be painted by performing appropriate tests. If the surfaces are found to be sufficiently alkaline to cause blistering and burning of the finish paint, correct this condition before application of paint. Do not paint over surfaces where the moisture content exceeds that permitted by the manufacturer's printed directions.

C. Wood:

1. Clean wood surfaces to be painted of all dirt, oil, or other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sandpaper smooth those finished surfaces exposed to view and dust off. Scrape and clean small, dry, seasoned knots and apply a thin coat of white shellac or other recommended knot sealer before application of the priming coat. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sandpaper smooth when dried.

2. Prime, stain, or seal wood required to be job painted immediately upon delivery to job. Prime edges, ends, faces, undersides, and backsides of such wood, including cabinets, counters, cases, paneling, etc.

3. When transparent finish is required, use spar varnish for backpriming.
4. Seal tops, bottoms, and cut-outs of unprimed wood doors with a heavy coat of varnish or equivalent sealer immediately upon delivery to job.

D. Ferrous Metals:

1. Clean ferrous surfaces, which are not galvanized or shop-coated of oil, grease, dirt, loose mill scale and other foreign substances by solvent or mechanical cleaning conforming to SSPC SP-1 and NACE-No. 4, SSPC SP-2, SSPC SP-3 or SSPC SP-7 (brush off blast cleaning).

E. Galvanized Surfaces:

1. Clean free of oil and surface contaminants with an acceptable non-petroleum based solvent per SSPC SP-1.

3.03 MATERIALS PREPARATION:

A. Mix and prepare painting materials in accordance with manufacturer's directions.

B. Store materials not in actual use in tightly covered containers. Maintain containers used in storage, mixing and application of paint in a clean condition, free of foreign materials and residue.

C. Stir materials before application to produce a mixture of uniform density and stir as required during the application of the materials. Do not stir surface film into the material. Remove the film and if necessary, strain the material before using.

3.04 APPLICATION:

A. General:

1. Apply paint in accordance with the manufacturer's directions. Use applicators and techniques best suited for the substrate and type of material being applied.
2. Apply additional costs when undercoats, stains or other conditions show through the final coat of paint, until the paint film is of uniform finish, color and appearance. Give special attention to insure that all surfaces, including edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

3. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Paint surfaces behind permanently-fixed equipment or furniture with prime coat only before final installation of equipment.

4. Paint interior surfaces of ducts where visible through registers or grilles with a flat, non-specular black paint.

5. Paint the back sides of access panels and removable or hinged covers to match the exposed surfaces.

6. Finish exterior doors on tops, bottoms and side edges the same as the exterior faces, unless otherwise indicated.

7. Sand lightly between each succeeding enamel or varnish coat.

8. Omit the first coat (primer) on metal surfaces which have been shop-primed and touch-up painted, unless otherwise indicated.

B. Scheduling Painting:

1. Apply the first-coat material to surfaces that have been cleaned, pretreated or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

2. Allow sufficient time between successive coatings to permit proper drying. Do not recoat until paint has dried to where it feels firm, does not defore or feel sticky under moderate thumb pressure, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
C. Minimum Coating Thickness:
   1. Apply each material at not less than the manufacturer's recommended spreading rate to establish a total dry film thickness as indicated or, if not indicated, as recommended by coating manufacturer.

D. Mechanical and Electrical Work:
   1. Painting of mechanical and electrical work is limited to those items exposed in occupied spaces and includes all exterior exposed work.

E. Prime Coats:
   1. Apply a prime coat of material which is required to be painted or finished, and which has not been prime coated by others.
   2. Recoat primed and sealed surfaces where there is evidence of suction spots or unsealed areas in first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.

F. Pigmented (Opaque) Finishes:
   1. Completely cover the provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness or other surface imperfections will not be acceptable.

G. Transparent (Clear) Finishes:
   1. Use multiple coats to produce glass-smooth surface film of each luster. Provide a finish free of laps, cloudiness, color, irregularity, runs, brush marks, orangpeel, nail holes, or other surface imperfections.
   2. Provide satin finish for final coats, unless otherwise indicated.
H. Completed Work:

1. Match approved samples for color, texture and coverage. Remove, refinish or repaint work not in compliance with specified requirements.

3.05 CLEAN-UP AND PROTECTION:

A. Clean-up:

1. During the progress of the work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.

2. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care no to scratch or otherwise damage finished surfaces.

B. Protection:

1. Protect work of other trades, whether to be painted or not, against damage by painting and finishing work. Correct any damage by cleaning, repairing or replacing and repainting, as acceptable to the Architect.

2. Provide "Wet Paint" signs as required to protect newly-painted finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of painting operations.

3. At the completion of work of other trades, touch-up and restore all damaged or defaced painted surfaces.

END OF SECTION 09900
SECTION 09952 - VINYL WALLCOVERING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. The extent of vinyl wallcovering is shown on the drawings and in schedules.

1.03 QUALITY ASSURANCE:

A. Test Panels: Install test panels for full-width and corner applications of vinyl wallcovering materials in area designated by the Architect. Test panels accepted by the Architect will be used as the standard of comparison for the work. Replace test panels which are not acceptable to the Architect until satisfactory installation is achieved.

B. Manufacturer: Provide vinyl wallcovering produced by the following manufacturer:

1. Colour & Design, North Little Rock, Arkansas

1.04 SUBMITTALS:

A. Manufacturer's Data:

1. For information only, submit four (4) copies of each manufacturer's technical data and installation instructions for vinyl wallcovering and installation materials. Transmit copy of each instruction to the Installer.

B. Samples:

1. Submit three (3) samples of each type of vinyl wallcovering with two (2) samples board backing. Submit 12" square samples to illustrate the range, color and pattern variation. Include finished materials as required. Review of samples will be for design, color, texture and pattern only. Compliance with all other requirements is the exclusive responsibility of the Contractor.
C. Maintenance Instructions:

1. Submit four (4) copies of the vinyl wallcovering manufacturer's printed instructions for maintenance of the installed work. Include name of manufacturer, material brand name, color and texture designation, and precautions for the use of cleaning materials and methods which could damage the wallcovering.

D. Replacement Materials:

1. After completion of work, deliver to the project site not less than five (5) lin. yds. of each color and pattern of vinyl wallcovering installed.

   a. Furnish replacement materials from the same manufactured sequence as the materials installed.

1.05 DELIVERY AND STORAGE:

A. Comply with the manufacturer's instructions and recommendations and as herein specified.

B. Deliver materials to the project site in original packages or containers clearly labeled to identify manufacturer, brand name, quality or grade, and fire hazard classification.

C. Store materials in original undamaged packages or containers. Do not store vinyl wallcovering fabric in an upright position. Maintain temperature in storage area above 40 degrees F.

1.06 JOB CONDITIONS:

A. Maintain a constant minimum temperature of not less than 60 degrees F. at areas of installation for at least 72 hours before, and 48 hours after the application of materials.
PART 2 - PRODUCTS

2.01 MATERIALS:

A. Fire Hazard Classification:

1. Provide materials bearing the UL label and marking, indicating the fire hazard classification of the wallcovering, as determined by ASTM E 84 complying with the following fire hazard classification.

   a. Flame spread not more than 10.
   b. Fuel contributed: 0.
   c. Smoke developed not more than 25.

B. Vinyl Wallcovering:

1. Comply with FS CCC-W-408 for the type and class required, and as herein specified. Provide Class 2 mildew-resistant backing unless otherwise specified. Comply with the requirements of ASTM D 1308 for determining stain resistance. Vinyl wallcovering shall contain bactericidal additives to inhibit microbiological growth of staphylococcus aureus, escherichia coli, and aspergillus niger.

2. Heavy Duty: Type II, total weight 21 oz. per sq. yd.

3. Color and Texture:

   a. Canton crepe silk as manufactured by Colour & Design
      1. Colour & Design

   b. Colors selected from the following:
      1. Colors: TO BE DETERMINED
      2. Color: Multiple colors to be selected.

      Available from: Fashion Architectural Wallcoverings - Contact : Andrea Angers, 248-302-1355 cell

C. Adhesive:
1. Manufacturer's recommended adhesive, primer and sealer, manufactured expressly for use with the selected vinyl wallcovering. Provide materials which are mildew-resistant and nonstaining to the wallcovering.

PART 3 - EXECUTION

3.01 INSPECTION:
   A. Installer must examine the areas and conditions under which vinyl wallcovering is to be installed and notify the General Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
   
   B. Install specified materials only when normal temperature and humidity conditions approximate the interior conditions that will exist when the building is occupied.

3.02 PREPARATION:
   A. Remove vinyl wallcovering materials from its packaging and allow to acclimatize to the area of installation 24 hours before application.
   
   B. Remove switch plates, wall plates, and surface-mounted fixtures, where wallcovering is to be applied.
   
   C. Prime and seal substrates in accordance with the vinyl wallcovering manufacturer's recommendations for the type of substrate material to be covered.

3.03 INSTALLATION:
   A. Place wallcovering panels consecutively in the order they are cut from rolls, including filling of spaces above or below openings. Hang by reversing alternate strips except on match patterns.
   
   B. Apply adhesive to back of wallcovering and place in accordance with the manufacturer's instructions. Install seams vertically and plumb, and at least 6" away from any corner; horizontal seams will be permitted only where specifically indicated. Place wallcovering continuously over internal and external corners. Overlap seams and double-cut to remove air bubbles, wrinkles, blisters and other defects. Cut wallcovering evenly to the edges of
the outlet box or support.

C. Trim salvages as required to assure color uniformity and pattern match at seams.

D. Remove excess adhesive along finished seams using warm water and a clean sponge, and wipe dry.

E. Install vinyl wallcovering with an intimate substrate bond, smooth, sponge, and wipe dry.

F. Replace removed plates and fixtures to verify cut edges of wallcovering are completely concealed.

3.04 CLEANUP:

A. Upon completion of work, remove surplus materials, rubbish and debris resulting from wallcovering installation and leave areas of work in a neat, clean condition.
SECTION 09970 – HIGH PERFORMANCE COATINGS

COATINGS PART 1  GENERAL

1.1 SECTION INCLUDES

A. Coating systems for interior masonry walls, holding cells, interior steel (metal doors, HM frames, stair stringers, guardrails, balusters, steel walkways, ladders, grilles, etc.). Note: Multiple colors will be used in individual areas.

1.2 REFERENCES


B. SSPC-SP 2 – Hand Tool Cleaning.

C. SSPC-SP 3 – Power Tool Cleaning.

D. SSPC-SP 6/NACE 3 – Commercial Blast Cleaning.

E. SSPC-SP 11 – Power Tool Cleaning to bare metal.

F. SSPC-SP 13/NACE 6 Surface Preparation of Concrete

G. ICRI – Concrete Surface Preparation Standards

1.3 DEFINITIONS

A. Definitions of Painting Terms: ASTM D 16, unless otherwise specified.

B. Dry Film Thickness (DFT): Thickness of a coat of paint in fully cured state measured in mils (1/1000 inch).

C. Concrete Surface Standard (CSP): Standard for roughness of the surface profile of the concrete measured 1-9 with 9 being the roughest measured with a visual mold.
1.4 SUBMITTALS

A. Comply with Section 01340 – “Shop Drawings, Product Data and Samples”.

B. Product Data: Submit manufacturer's product data for each coating, including generic description, complete technical data, surface preparation and application instructions.

C. Color Samples: Submit manufacturer’s color samples showing full range of standard colors.

D. Manufacturer’s Quality Assurance: Submit manufacturer’s certification that coatings comply with specified requirements and are suitable for intended application.

E. Applicator’s Quality Assurance: Submit list of a minimum of 5 completed projects of similar size and complexity to this Work. Include for each project:
   1. Project name and location.
   2. Name of owner.
   3. Name of contractor.
   4. Name of architect.
   5. Name of coating manufacturer.
   6. Approximate area of coatings applied.
   7. Date of completion.

F. Warranty: Submit manufacturer’s standard warranty.

1.5 QUALITY ASSURANCE

A. Manufacturer’s Qualifications:
   1. Specialize in manufacture of coatings with a minimum of 10 years successful experience.
   2. Able to demonstrate successful performance on comparable projects.

B. Applicator’s Qualifications:
   1. Experienced in application of specified coatings for a minimum of 5 years on projects of similar size and complexity to this Work.

C. Preapplication Meeting: Convene a pre-application meeting [2] two weeks before start of application of coating systems. Require attendance of parties directly affecting work of this section, including Contractor, Architect, applicator and manufacturer’s representative. Review the following:

1. Environmental requirements.
2. Protection of surfaces not scheduled to be coated.
4. Application.
5. Repair.
6. Field quality control.
7. Cleaning.
8. Protection of coating systems.
9. One-year inspection.
10. Coordination with other work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying:
   1. Coating or material name.
   2. Manufacturer.
   3. Color name and number.
   4. Batch or lot number.
   5. Date of manufacture.
   6. Mixing and thinning instructions.

B. Storage:
   1. Store materials in a clean dry area and within temperature range in accordance with manufacturer's instructions.
   2. Keep containers sealed until ready for use.
   3. Do not use materials beyond manufacturer’s shelf life limits.

C. Handling: Protect materials during handling and application to prevent damage or contamination.
1.7 ENVIRONMENTAL REQUIREMENTS

A. Weather:
   1. Air and Surface Temperatures: Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with manufacturer’s instructions.
   2. Surface Temperature: Minimum of 5 degrees F (3 degrees C) above dew point.
   3. Relative Humidity: Prepare surfaces and apply and cure coatings within relative humidity range in accordance with manufacturer’s instructions.
   4. Precipitation: Do not prepare surfaces or apply coatings in rain, snow, fog or mist.
   5. Wind: Do not spray coatings if wind velocity is above manufacturer’s limit.

B. Ventilation: Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with manufacturer’s instructions.

C. Dust and Contaminants:
   1. Schedule coating work to avoid excessive dust and airborne contaminants.
   2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. PPG High Performance Coatings, 23361 Telegraph Road, Southfield, MI 48034 Contact: Jim Kacir Phone: (248) 520-9864. Web Site: www.ppghpc.com

2.2 COATING SYSTEMS FOR EXISTING CONCRETE FLOORS (DECORATIVE CHIP) 
(omit decorative chips/flakes at Sterling Heights HS Performing Arts Center)

A. Chemical Exposure, Physical Abuse:
   1. System Type: Modified polyamine epoxy.
   2. Surface Preparation: SSPC-SP 13/ICRI-CSP 3-5.
   3. Prime Coat: MegaSeal HSPC 99-12700 at 8.0 to 10.0 mils
   4. Intermediate Coat: MegaSeal SL 99-12600 15.0 to 20.0 mils DFT with complete broadcast to refusal of MegaSeal FLK decorative flake.
   5. Finish Coat: MegaSeal SL 99-12600 10.0 to 20.0 mils DFT.

B. Chemical Exposure, Physical Abuse:
   1. System Type: Modified polyamine epoxy.
   2. Surface Preparation: SSPC-SP 13/ICRI-CSP 3-5.
   3. Prime Coat: Tnemec Series 281 tneme-glaze at 8.0 to 10.0 mils DFT with complete broadcast to refusal of Tnemec Series 224C decorative flake.
   4. Intermediate Coat: Tnemec Series 284 deco-clear at 8.0 to 10.0 mils DFT.
   5. Finish Coat: Tnemec Series 284 deco-clear at 8.0 to 10.0 mils DFT.

2.3 INTERIOR MASONRY WALLS

A. Chemical Exposure, Physical Abuse:
   1. System Type: Waterborne cementitious acrylic/waterborne acrylic epoxy.
   2. Surface Preparation: Clean and dry.
   PPG
   1. Prime Coat: PITT-GLAZE 16-90 Interior/Exterior Block Filler Latex at 6.0 to 13.0 DFT.
   2. Intermediate Coat: PITT-GLAZE® WB 16-551 Acrylic Epoxy at 2.0 to 3.0 mils DFT.
   3. Finish Coat: PITT-GLAZE® WB 16-551 Acrylic Epoxy at 2.0 to 3.0 mils DFT.
   Tnemec
   1. Prime Coat: Tnemec Series 130 envirofill at manufacturers recommended spreading rate.
   2. Intermediate Coat: Tnemec Series 113 H.B. tneme-tufcoat at 4.0 to 6.0 mils DFT.
   3. Finish Coat: Tnemec Series 113 H.B. tneme-tufcoat at 4.0 to 6.0 mils DFT.
2.4 PAINTED INTERIOR STEEL

A. Surface prep: Shall comply with SSPC SP10.
   1. Shop Primer: 94-258 MULTIPRIME® Fast Dry Universal Primer at 1.5 to 2.0 mils DTF
   2. Field Intermediate: PITT-GLAZE® WB 16-551 Acrylic Epoxy at 2.0 to 3.0 mils DFT.
   3. Field Finish: PITT-GLAZE® WB 16-551 Acrylic Epoxy at 2.0 to 3.0 mils DFT.

B. Atmospheric, Chemical, or UV Exposure, Physical Abuse:
   2. Surface Preparation: SSPC-SP6 commercial blast cleaning.
   3. Shop Primer: Tnemec Series 90-97 Tneme-zinc at 2.5 to 3.5 mils DFT.
   4. Shop Intermediate Coat: Tnemec Series 66 hi-build epoxoline at 3.0 to 5.0 mils DFT.
   5. Shop Finish Coat: Tnemec Series 297 Enviro-glaze at 2.0 to 3.0 mils DFT.
   6. Finish Color: As selected by Architect from manufacturer’s standard colors.

2.5 INTERIOR GYPSUM BOARD

A. Chemical Exposure, Physical Abuse, Impact:
   1. System Type: Pre-Catalyzed Epoxy
   2. Surface Preparation:
   3. Prime Coat: 17-921 SealGrip Acrylic Universal Primer at 1.5 to 2.0 mils DFT.
   4. Intermediate Coat: 16-510 PITT-GLAZE® WB1 Interior Semi-Gloss Pre-Catalyzed Water-Borne Acrylic Epoxy at 1.5 to 2.0 mils DFT
   5. Finish Coat: 16-510 PITT-GLAZE® WB1 Interior Semi-Gloss Pre-Catalyzed Water-Borne Acrylic Epoxy at 1.5 to 2.0 mils DFT
   6. Total DFT: 4.5 to 6.0 mils.
B. Chemical Exposure, Physical Abuse, Impact:
   1. System Type: 100% solids epoxy.
   2. Surface Preparation:
      3. Prime Coat: Tnemec Series 201, epoxoprime 6.0 to 8.0 mils DFT.
      4. Intermediate Coat: Tnemec Series 270 stranlok, 25.0 to 40.0 mils DFT.
      5. Finish Coat: Tnemec Series 280 tneme-glaze 6.0 to 8.0 mils DFT.
      6. Total DFT: 37.0 to 56.0 mils.

2.6 ACCESSORIES

A. Coating Application Accessories:
   1. Accessories required for application of specified coatings in accordance with manufacturer’s instructions, including thinners.
   2. Products of coating manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which coating systems are to be applied. Notify the General Contractor in writing of areas or conditions not acceptable. Do not begin surface preparation or application until unacceptable areas or conditions have been corrected.

3.2 PROTECTION OF SURFACES NOT SCHEDULED TO BE COATED

A. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings.

B. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

3.3 SURFACE PREPARATION OF STEEL

A. Prepare steel surfaces in accordance with manufacturer’s instructions.

B. Fabrication Defects:
1. Correct steel and fabrication defects revealed by surface preparation.
2. Remove weld spatter and slag.
3. Round sharp edges and corners of welds to a smooth contour.
4. Smooth weld undercuts and recesses.
5. Grind down porous welds to pinhole-free metal.
6. Remove weld flux from surface.

C. Ensure surfaces are dry.

D. Interior Steel Surfaces, Moderate to Severe Exposure: Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products and other foreign matter in accordance with SSPC- SP6.

E. Abrasive Blast-Cleaned Surfaces: Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.

F. Primer: Prepare field primer to receive field coat in accordance with manufacturer’s instructions.

3.4 SURFACE PREPARATION OF CONCRETE

A. Prepare concrete surfaces in accordance with manufacturer’s instructions.

B. Defects
   1. Remove spalled or deteriorated areas.
   2. Remediate concrete surfaces per Section 03730 “Concrete Rehabilitation”. Let remediated areas cure per manufacturers recommendations.
   3. Remove deteriorated mortar joints in masonry. Tuckpoint and cure per manufacturer’s recommendations.

C. Ensure surfaces are dry.

D. Remove visible oil, grease, dirt, dust, rust stains, paint, and other foreign matter in accordance with SSPC - SP13/NACE 6 surface preparation of concrete.

E. Primer: Prepare field primer to receive field coat in
accordance with manufacturer’s instructions.

3.5 SURFACE PREPARATION OF GYPSUM BOARD SURFACES

A. Prepare gypsum materials in accordance with manufacturer’s instructions.

B. Defects: Repair drywall surfaces of nail holes, scratches, dents, holes and other surface imperfections per Spec Section 09250 Gypsum Drywall. Sand joint compound smooth and feather edge.

C. Ensure surfaces are dry and free of oil, grease, curing compounds/sealers, dirt, dust, and other contaminants.

D. Primer: Prepare field primer to receive field coat in accordance with manufacturer’s instructions.

3.6 APPLICATION

A. Apply coatings in accordance with manufacturer’s instructions.

B. Mix and thin coatings, including multi-component materials, in accordance with manufacturer’s instructions.

C. Keep containers closed when not in use to avoid contamination.

D. Do not use mixed coatings beyond pot life limits.

E. Use application equipment, tools, pressure settings and techniques in accordance with manufacturer’s instructions.

F. Uniformly apply coatings at spreading rate required to achieve specified DFT.

G. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.

H. Stripe paint with brush critical locations on steel such as...
welds, corners and edges using specified primer.

3.7 REPAIR

A. Materials and Surfaces Not Scheduled To Be Coated: Repair or replace damaged materials and surfaces not scheduled to be coated.

B. Damaged Coatings: Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture or color.

C. Coating Defects: Repair in accordance with manufacturer’s instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.8 FIELD QUALITY CONTROL

A. Inspector’s Services:
1. Verify coatings and other materials are as specified.
2. Verify surface preparation and application are as specified.
3. Verify DFT of each coat and total DFT of each coating system are as specified using wet film and dry film gauges.

4. Coating Defects: Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.
   a. Check for holidays on interior steel immersion surfaces using holiday detector.

5. Report:
   a. Submit written reports describing inspections made and actions taken to correct nonconforming work.
   b. Report nonconforming work not corrected.
   c. Submit copies of report to Architect, Owner’s Representative and General Contractor.

B. Manufacturer’s Field Services: Manufacturer’s
representative shall provide technical assistance and guidance for surface preparation and application of coating systems.

3.9 CLEANING

A. Remove temporary coverings and protection of surrounding areas and surfaces.

3.10 PROTECTION OF COATING SYSTEMS

A. Protect surfaces of coating systems from damage during construction.

3.11 ONE-YEAR INSPECTION

A. Owner will set date for one-year inspection of coating systems.

B. Inspection shall be attended by Owner, Contractor, Architect and manufacturer’s representative.

C. Repair deficiencies in coating systems as determined by Architect in accordance with manufacturer’s instructions.

END OF SECTION 09970
SECTION 10100 - MARKERBOARDS AND TACKBOARDS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. Provide allowance for (1) 4’ x 4’ markerboard and (2) 4’ x 4’ tackboards. Refer to Drawings for location.

B. The types of boards required include the following:
   1. Vinyl-faced tackboards.
   2. Porcelain enamel dry markerboards.

1.03 QUALITY ASSURANCE:

A. Fire Hazard Classification: Provide materials bearing UL label and marking indicating fire hazard classification of marking and tack surfaces, as determined by ASTM E 84, Class A and as follows.
   1. Flame spread not more than 25.
   2. Fuel contributed not more than 35.
   3. Smoke developed not more than 50.

B. In addition to the requirements of these specifications, comply with manufacturer's instructions and recommendations for all phases of the work, including preparation of substrate, installation of grounds and anchors, and application of materials.

C. Provide colors of material for marking markerboards and tackboards as selected by the Architect from manufacturer's standard colors.

D. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication where possible to ensure proper fitting of the work. However, do not delay job progress; allow for trimming and fitting wherever the taking of field measurements before fabrication might delay the work.
1.04 SUBMITTALS:

A. Product Data:

1. For information only, submit 4 copies of manufacturer's technical data and installation instructions for each material and component part. Include methods of installation for each type of substrate to receive units. Transmit copy of each instruction to the Installer.

B. Samples:

1. Submit 4 sets of samples for each color of markerboard and tackboard, trim, and accessories required. Provide 12" square samples of sheet materials and 12" lengths of trim members. Architect's review of samples will be for color, pattern, and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

C. Shop Drawings:

1. Submit shop drawings for markerboard and tackboard units. Include full-scale sections of typical trim members and dimensioned elevations. Show anchors, ground reinforcement, accessories, and installation details.

PART 2 - PRODUCTS

2.01 TACKBOARD:

A. Balanced Laminated Three-ply Construction:

1. Vinyl Fabric: Claridge
   a. Texture: Fabricork
   b. Colors as selected by Architect.
2. Backing: Single layer 1/2" thick.
3. Wrap all edges.

B. Manufacturer: Provide tackboard produced by one of the following:

1. Alliance Wall Corp.
2. Claridge Products and Equipment, Inc.
3. Polyvision Corp.
4. Newline
5. Marsh Industries
2.02 MARKERBOARD:

A. LCS Liquid Chalk Porcelain Enamel Writing Surface.
   1. Porcelain enamel finish on 24 gauge steel.
   2. Core: 3/8" thick particle board core complying with ANSI A208.1 Grade 1-M-1.
   3. Backing Sheet: 0.015" aluminum sheet.

B. Manufacturer:
   1. Claridge Products & Equipment, Inc. (Basis of Design)
   2. Polyvision
   3. Newline
   4. Marsh Industries

2.03 TRIM AND ACCESSORIES:

A. General: Fabricate frames and trim of not less than 0.062" thick aluminum alloy, size as shown to suit type of installation. Provide straight, single-length units wherever possible and keep joints to a minimum. Miter corners to a neat, hairline closure. Furnish exposed aluminum trim, accessories, and fasteners with satin anodized finish AA-M31A31, unless otherwise indicated.

   1. Except as otherwise indicated, provide manufacturer's standard "narrow" trim units, approximately 1/2" wide.
   
   2. When structural support accessories are required for markerboards and tackboards in addition to normal trim, provide such additional support or modify trim as required to provide necessary support.
      
      a. Provide snap-on trim with no visible screws or exposed joints.

B. Chalktrough: Furnish continuous aluminum chalktrough for each markerboard unless otherwise indicated as follows:

   1. Solid extrusion, manufacturer's standard continuous box type, aluminum marker tray with slanted front and cast. Aluminum end closures for each markerboard.

C. Map rails, map hooks (2 map hooks for every 48" of map rail), map rail end stops for all markerboards and tackboards.
2.04 FABRICATION:

A. Provide factory-assembled markerboards and tackboards.

B. All boards are to be in sizes indicated on plans. Boards are to be wall mounted in a stationary position.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Installer must examine the areas and conditions under which units are to be installed and notify the General Contractor, in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 INSTALLATION:

A. Install new boards in locations and mounting heights as shown on the drawings and in accordance with the manufacturer's instructions. Provide all grounds, clips, backing materials, brackets, and anchors for a complete installation.

B. Deliver factory-built new markerboard and new tackboard units completely assembled in one piece without joints, whenever possible. Where dimensions exceed panel size, provide 2 or more pieces of equal length, as acceptable to the Architect. When overall dimensions require delivery in separate units, prefit at the factory, disassemble for delivery, and make final joint at the site. Use splines at joints to maintain surface alignment and smooth joints.

C. Install new units with concealed hangers plumb and level, in accordance with the manufacturer's printed instructions.

D. Coordinate job-assembled units with grounds, trim, and accessories. Join all parts with neat, precision fit.

END OF SECTION 10100
SECTION 10160 – TOILET PARTITIONS

PART 1 - GENERAL

1.01 SUBMITTALS:

A. Plastic compartment work includes the following, where indicated:
   1. Floor mounted overhead-braced compartments.

B. Furnish all labor and materials necessary for the completion of work in this section as shown on the contract drawings and specified herein.

C. Work in this section shall include, but is not limited to:
   1. Toilet compartments, compartment doors.
   2. Urinal screens
   3. Hardware for toilet compartments.
   4. Shop drawings and working drawings.
   5. Manufacturer’s guarantee/warranty.

D. Related work specified elsewhere shall include accessories and anchorage/blocking for attachment of partitions.

1.02 PRODUCT:

A. Submit (3) three sets of shop drawings and details for Architect’s approval.

B. Colors shall be selected from the manufacturer’s full range of colors.

C. Submit 6” square color samples of each color and hardware samples for approval by the Architect.

PART 2 - PRODUCTS

2.01 MANUFACTURER:

A. Provide toilet and urinal partitions and screens by one of the following manufacturer’s:
   1. SCRANTON PRODUCTS 801 E. Corey Street, Scranton, PA, 570-343-0997.
   2. Bradley Corp., P.O. Box 309, Menomonee Falls, WI, 1-800-272-3539.
   3. ASI Global Partitions, 2171 Liberty Hill Road, Eastanollee, Georgia, 1-706-827-2700.
2.02 MATERIALS:

A. Doors, panels, pilasters and privacy screens and supports shall be 1” thick constructed from High-Density Polyethylene (HDPE) resins. Partitions and privacy screens shall be fabricated from polymer resins compounded under high pressure, forming a single component which is waterproof, nonabsorbent and has a self-lubricating surface that resists marks from pens, pencils, markers and other writing instruments. All plastic components shall be covered with a protective plastic masking.

2.03 CONSTRUCTION:

A. Doors, panels, pilasters and privacy screens shall be 1” thick with all edges rounded to a ¼” radius.

B. Doors and dividing panels shall be 55” high and mounted at 14” above the finished floor. Fasten an aluminum heat sink to the bottom edges.

C. Pilasters shall be 82” high (standard) and fastened into a 3” high pilaster shoe with a stainless steel, torx head sex bolts.

2.04 HARDWARE:

A. Door hardware shall be as noted:

1. Hinges shall be integral, fabricated from the door and pilaster with no exposed metal parts, adjustable in 30 degree increments to hold door open up to 90 degrees.

2. Door strike/keeper shall be 6” long and made of heavy-duty extruded aluminum (6436-T5 alloy) of either an anodized finish or a bright dipped anodized finish, with wrap around flanges and secured to the pilasters with stainless steel, torx head sex bolts. Bumper shall be made of extruded black vinyl.

3. Latch and housing shall be made of heavy-duty extruded aluminum (6463-T5 alloy). The latch housing shall have either an anodized finish or a bright dipped anodized finish, and the slide bolt and button shall have a black anodized finish.

4. Each door shall be supplied with one coat bumper/hook and 2 door pulls made of chrome plated zamak. Outswing doors shall be supplied with a door stop made of charm plated zamak.
B. Plaster shoes shall be 3" high (type 304, 20 gauge) stainless steel. Pilaster shoes shall be secured to the pilaster with a stainless steel, torx head sex bolt.

C. Wall brackets for partitions shall be 1½” stirrup type made of heavy-duty aluminum (6463-T5 alloy) with either an anodized or a bright dipped anodized finish. Stirrup brackets shall be fastened to pilasters and panels with stainless steel, torx head sex bolts.

D. Headrail shall be made of heavy-duty extruded aluminum (6463-T5 alloy) with anti-grip design and integrated curtain track. The headrail shall have an anodized finish and shall be fastened to the headrail bracket by a stainless steel, torx head sex bolt, and fastened to the top of the pilasters with stainless steel, tamper resistant torx screws.

E. Headrail brackets shall be of heavy duty extruded aluminum with an anodized finish or 20 gauge stainless steel with a satin finish, and secured to the wall with #14 stainless steel screws.

PART 3 - EXECUTION

3.01 PREPARATION:

A. Examine areas to receive toilet and urinal partitions/compartments for correct height and spacing of anchorage/bolting and plumbing fixtures that may affect installation of partitions/compartments. Report any discrepancies to the Architect.

B. Take complete and accurate measurements of complete toilet compartment locations.

C. Start of work constitutes acceptance of job.

3.02 INSTALLATION:

A. Install partitions rigid, straight, plumb, and level, with plastic laid out as shown on shop drawings and manufacturer’s installation instructions.

B. All doors and panels to be mounted at 14” above finished floor.

C. Clearances at vertical edges of doors shall be uniform top to bottom and shall not exceed 3/8”.

TOILET PARTITIONS
D. Clearances at pilasters and panels shall be uniform top to bottom and shall not exceed ½”

E. Clearances between panels and walls shall be uniform top to bottom and shall not exceed 1”.

F. No evidence of cutting, drilling, and/or patching shall be visible on the finished work.

G. Finished surface shall be cleaned after installation and be left free of all imperfections.

3.03 WARRANTY:

A. Submit manufacturer’s standard guarantee for HDPE plastic against breakage, corrosion, and delamination under normal conditions for 15 years from the date of receipt by the customer. If materials are found to be defective during that period for reasons listed above, the materials will be replaced free of charge. (Labor not included in warranty).

END OF SECTION 10160
SECTION 10350 - FLAG POLE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 SCOPE OF WORK:

A. Work included in this Section consists of all labor, materials, equipment, and incidentals required for complete installation of flag pole and flag where shown on drawings, specified herein.

1.03 QUALITY CONTROL:

A. Shop Drawings: Submitted for approval construction details, trim, and other related items, materials, finish, and necessary accessories.

1.04 MATERIALS:

A. Pole: (2) above grade, cone tapered type of .188" thick 6063-T6 seamless aluminum, deep luster finish. Specification based on Concord Industries Inc., concealed halyard system or Pole Tech-flag pole manufacturer of east Setauket, New York. Refer to Drawing for height.

B. Fittings: No. 14 gauge spun aluminum ball and concealed halyard system.

C. Foundation tube: Galvanized corrugated steel tube No. 16 gauge 12" o.d. with 16 x 16 base and 9 x 9 support plate.

D. Dry sand and 3/4" diameter steel lighting; rod same length as concrete foundation.

E. Concrete: Refer to Spec Section 03001 “Concrete”.

F. Flag: Provide and hang from pole a commercial type American flag of nylon construction with sewn stripes and embroidered stars. Provide with canvas rope and heading tape with thimbles. Provide with all accessories required to raise and lower flag. Flag available at Rocket Enterprises, Warren, MI 586-751-7600. Flag size: 6’ x 10’.
1.05 INSTALLATION:

A. Paint base and foundation tube inside and outside with asphaltum paint (2 coats).

B. Excavation at least 4 times pole butt diameter in width and 5 times pole butt diameter at top and 4'-0" minimum depth.

C. Set tube in hole per manufacturers detail making sure grounding spike is grounded.

D. Center pole plumb and true with wooden wedges then fill with dry screened sand, tamped at 6" intervals. Moisture seal at top with 2 inches of thiokol type sealant.

E. Install all accessories and make ready for use.

F. Fill excavation with concrete to grade and trowel to gentle slope. Cure.

END OF SECTION 10350
PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. The provisions of the General Conditions, Supplementary Conditions, and the Sections included under Division 1, General Requirements, are included as a part of this Section as though bound herein.

1.02 SUMMARY

A. Provide labor, materials, and equipment necessary for the complete installation of identifying devices as indicated, including:

1. Interior Signage
   a. Refer to Construction Drawings for types and locations.

2. Exterior Pin Mounted Building Signage

1.03 SUBMITTALS:

A. Submit product data for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

B. Submit Shop Drawings showing fabrication and erection of signs. Include plans, elevations, and large scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories, and installation details.

C. Signage shall have 2 colors, background and letters. Match sample provided by Architect.

D. Provide samples for verification of color, pattern, and texture selected and compliance with requirements indicated:
   1. Cast Acrylic Sheet: Provide a sample panel not less than 8-1/2 inches by 11 inches for each material, color, texture, and pattern required. On each panel include a representative sample of the graphic image process required, showing graphic style, and colors and finishes of letters, numbers, and other graphic devices.
1.04 QUALITY ASSURANCE:


B. Signage shall be provided to conform with the Americans with Disabilities Act Accessibility Guidelines (ADAAG) and State and Local Regulations.

PART 2 - PRODUCTS

2.01 MANUFACTURER:

A. Manufacturers: (Interior Signage) Subject to compliance with requirements, provide signage by one of the following:

1. ASI Sign Systems, Detroit, Michigan
2. Diskey Sign Corp. Fort Wayne, Indiana
3. Detroit Marking Products, Detroit, MI
4. The Supersine Company (Div. of Stamp-Rite, Lansing, MI
5. Roban, Lakemore, Ohio
6. Best Signs, Montrose, Colorado

B. Manufacturers: (Exterior Pin Mounted Building Signage & Bronze Seals) Subject to compliance with requirements, provide signage by one of the following:

1. Metal Arts Division of L & H Manufacturing Company, Mandan, North Dakota
2. Other Architect approved equal.

C. Products of other manufacturers will be considered for acceptance provided they equal or exceed the material requirements and functional qualities of the specified product. Requests for Architect’s approval must be accompanied by the “Substitution Request Form” and complete technical data for evaluation. All materials for evaluation must be received by the Project Manager and Specification Department at least 10 days prior to bid due date. Additional approved manufacturers will be issued by Addendum.

1. Refer to Division 1 Instructions to Bidders and Substitution Request Form for additional requirements.
2.02 MATERIALS:

A. Cast Acrylic Sheet: Provide cast (no extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 degrees F and of the following general types:

1. Thickness: 1/8 inch.
2. Colors as selected from manufacturers full range of offerings.

B. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

C. Anchors and Inserts: Use nonferrous metal or hot dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete masonry work.

D. Colored Coatings for Acrylic Plastic Sheet: Use colored coatings, including inks and paints for copy and background color that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for the application intended.

2.03 INTERIOR SIGNAGE:

A. Signage, General:

1. Graphic Process; Raised letters and Braille shall be formed as an integral part of the sign face. Surface applied letters and Braille are not allowed.
2. Letters: Letters and numbers shall have width to height ratio between 3:5 and 1:1 and a stroke width to height ratio between 1:5 and 1:10. Letters and numbers shall be raised 1/32 inch, uppercase, sans serif or simple sans serif type and shall be accompanied with Grade 2 Braille. Raised characters shall be 5/8 inch high minimum and 2 inches high maximum.
3. Ease sign edge and radius corners 3/8 inch.
4. Material
   a. Acrylic plastic
B. Toilet Room Handicapped Signs

1. Provide one sign depicting International Men/Women Symbol along with the words “Men” or “Women” indicated on the sign at each toilet room, equipped with facilities for the handicapped as indicated on the Signage Schedule.

C. Interior Room Name

1. Layout of room name shall be as directed by the Architect.
2. Number of signs required:
   a. Refer to Drawings
3. Provide signs with clear acrylic name plate(s) as indicated on Signage Types.

PART 3 - EXECUTION

3.01 INSTALLATION:

A. General: Located sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer’s instructions.
   1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

B. Wall Mounted Panel Signs: Attach panel signs to wall surfaces using the method indicated below:
   1. Mount with adhesive as recommended by manufacturer.
      a. Attach panel signs to glass surfaces with a back panel to cover adhesive mounting method.
   2. Mount with nonremovable oval head screws, using plastic plugs where mounted on masonry.

3.02 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to the manufacturer’s instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION 10400
SECTION 10500 - METAL LOCKERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. The extent of new metal lockers is shown on the drawings and is generally as follows:

1. Type “A” 15"w x 15"d x 36"h ‘Double Tier’ standard locker (72” high) (20 openings).

1.03 QUALITY ASSURANCE:

A. Provide metal lockers as a complete unit produced by a single manufacturer, including necessary mounting accessories, fittings, and fastenings.

B. Manufacturer: Provide metal lockers as manufactured by Republic Steel Corporation or other as approved by Owner.

1.04 SUBMITTALS:

A. Manufacturer's Data:

1. For information only, submit two (2) copies of manufacturer's technical data and installation instructions for the metal locker units. Transmit a copy of each instruction to installer.

B. Samples:

1. Submit three (3) samples, on metal, of each color and finish that are required for lockers. Review will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.
C. Shop Drawings:


1.05 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. Do not deliver metal lockers until building is ready for their installation. Protect from damage during delivery, handling, storage and installation.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Sheet Steel: Cold-rolled steel for doors and door frames. Cold-rolled steel or annealed, specially treated steel for other parts. All steel free from buckle, scale and surface imperfections.

B. Fasteners: Cadmium, zinc or nickel plated steel. Exposed bolt heads, slotless type. Provide self-locking nuts or lock washers for nuts on moving parts, or otherwise prevent loosening of nuts. Do not expose bolts or rivet heads on fronts of lockers or frames.

C. Equipment: Furnish of zinc-plated steel, formed with ballpoints and attached with two bolts or rivets.

2.02 LOCKERS:

A. Door Frames: Shall be 16 gauge formed into deep, 1'' face channel shapes with a continuous vertical door strike integral with the frame on both sides of the door opening. Double, triple or four tier locker cross frame members shall be 16 gauge channel shaped securely welded to vertical framing members to ensure a square and rigid assembly. Intermediate cross frame members are not required on box lockers.
B. Body: The body of the locker consists of 24 gauge uprights sheets, backs tops, bottoms and shelves. Tops, bottoms and shelves are flanged on all four sides; backs are flanged on two sides. Uprights shall be offset at the front and flanged at the rear to provide a double lapped rear corner. All bolts and nuts shall be zinc plated.

C. Handles: A non-protruding 14 gauge lifting trigger and slide plate shall transfer the lifting force for actuating the lock bar when opening the door. The exposed portion of the lifting trigger shall be encased in a molded ABS thermoplastic cover that provides isolation from metal-to-metal contact and be contained in a formed 20 gauge stainless steel recessed pocket meets ADA accessibility requirements. This stainless steel pocket shall contain a recessed area for an Owner supplied padlock and a mounting area for the number plate.

D. Pre-Locking Device: All "tiered" lockers shall be equipped with a positive automatic pre-locking type, whereby the locker may be locked while door is open and then closed without unlocking and without damaging locking mechanism.

E. Doors: Shall be 16 gauge or 18 gauge steel for short or narrow doors as required by manufacturer’s design, formed with a full channel shape on the lock side to fully conceal the lock bar, channel formation on the hinge side and right angle formation across the top and bottom. Single tier doors 60” and 72” in height and 18” and wider shall have a diagonal reinforcing angle welded to inner surface. Doors for Standard Box Lockers 3, 4, 5 and 6 openings high are 16 or 18 gauge steel and shall be formed with right angle flanges on all four sides. Locker doors shall be ventilated by louvers on the face of each door, top and bottom.

F. Hinges: Hinges shall be 2'' high, 5-knuckle, full loop, tight pin style, securely welded to frame and double riveted to the inside of the door flange. Locker doors 42'' high and less shall have two hinges. Doors over 42'' high shall have three hinges.
G. Latching: Latching shall be one-piece, pre-lubricated, spring steel latch completely contained within the lock bar under tension to provide rattle-free operation. The lock bar shall be of precoated, double-channel steel construction. The lock bar shall be securely contained in the door channel by self-lubricating polyethylene guides that isolate the lock bar from metal-to-metal contact with the door. There shall be three latching points for lockers over 42" in height and two latching points for all tiered lockers 42" and under in height. The lock bar travel is limited by contacting resilient elastomeric cushioning devices located inside the lock bar. Frame hooks to accept latching shall be of heavy gauge steel, set close in and welded to the frame. Continuous vertical door strike shall protect frame hooks from door slam damage. The impact caused by the door closing shall be absorbed by a soft rubber silencer which is to be securely installed on each frame hook. Box locker doors shall be equipped with a padlock hasp and a stainless steel strike plate with an integral handle pull.

2.03 LOCKER ACCESSORIES:

A. Interior Equipment:

1. Single tier lockers over 42” high shall have one hat/book shelf. Other tiered lockers do not require shelves. All single, double and triple tier lockers shall have one double prong back hook (single prong in 9” width) and two single prong wall hooks in each compartment. All hooks shall be made of steel, formed with ball points, zinc-plated and attached with two bolts or rivets. Lockers under 20” high are not equipped with hooks.

B. Number Plates: Each locker shall have a polished aluminum number plate with black numerals not less than 1/2" high. Plates shall be attached with rivets to the lower surface within the recessed handle pocket. Number sequence shall be determined by Owner.

C. Tops:

1. Provide continuous flat top on all non-recessed lockers.

D. Base: Provide zee base.

E. Trim: Provide fillers at sides and top as shown or required.
F. Boxed End: Provide boxed finished end panels on all exposed ends.

G. Construction: Fabricate lockers square, rigid and without warp with metal faces flat and free of dents or distortion. Make all exposed metal edges safe to the touch. Weld frames together. Weld, bolt, or rivet other joints and connections as standard with manufacturer. Grind exposed welds flush.

H. Finishing: Chemically pretreat metal with degreasing and phosphatizing process. Apply baked-on enamel finish to all surfaces, exposed and concealed, except plates and non-ferrous metal. Architect will select from manufacturer's standard colors.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Installer must examine the areas and conditions under which metal wardrobe lockers are to be installed and notify the General Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.02 INSTALLATION:

A. Install metal lockers at the locations shown in accordance with the manufacturer's instructions for a plumb, level, rigid, and flush installation.

B. Space fastenings about 48" O.C. and apply through back-up reinforcing plates where necessary to prevent metal distortion. Conceal all fasteners wherever possible.

C. Install trim, metal zee base, and sloping top units where indicated to provide a flush, hairline joint against adjacent surfaces. Install with concealed fasteners.

D. Touch-up marred finishes, or replace if not acceptable to the Architect. Use only materials and finishes as recommended or furnished by the locker manufacturer.
E. Adjust doors and latches to operate easily without bind. Verify satisfactory operation of integral locking devices.

F. Where required, provide metal filler panels for closure to adjacent surfaces, factory-finishes to metal lockers.

END OF SECTION 10500
SECTION 10522 - FIRE EXTINGUISHERS AND CABINETS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. The extent of fire extinguishers and wall mounted brackets is shown on the drawings.

1.03 QUALITY ASSURANCE:

A. Manufacturer: Provide fire extinguishers with wall mounted brackets and fire blanket cabinets manufactured by one of the following:

1. J. L. Industries (basis of design)
2. Larsens Manufacturing Company
3. Potter Roemer
4. Nystrom

1.04 SUBMITTALS:

A. Manufacturer's Data:

1. For information only, submit two (2) copies of manufacturer's technical data and installation instructions for fire extinguisher required. Transmit copy of each instruction to the installer.

PART 2 - PRODUCTS

2.01 FIRE EXTINGUISHERS AND CABINETS:

A. General: Provide fire extinguisher cabinets including standard 10 lb. multi-purpose dry chemical fire extinguishers, as follows:

1. Recessed, 1-1/2" return trim door frame similar to J.L. Industries Cosmopolitan Model #1036 with solid door.
B. Metal Gage: Provide cabinets fabricated of the following minimum equivalent steel gages.
   1. Box: 20 gage.
   2. Trim Frame: 18 gage.
   3. Tubular Door Perimeter Frame: 20 gage:

C. Construction: One-piece tubular door frames, mitered and welded. One-piece metal trim frame, to suit cabinet style required. Weld all joints and grind smooth. Provide manufacturer's standard steel box with white baked enamel interior finish.

D. Steel Doors and Trim: Manufacturer's standard, #4 stainless steel door frame and trim, style as indicated.

E. Door Hardware: Continuous type hinge permitting door to open 180 degrees. Provide Futura "fire handle" on all cabinets, unless noted otherwise.

F. Provide fire-rated cabinets where indicated on plan or if not indicated, at all locations installed in a fire-rated wall as shown on the life safety plan.

G. Provide each fire extinguisher cabinet with a plastic sign: 4" x 18" 3D tent “fire extinguisher” #235.

2.02 FIRE EXTINGUISHERS (without cabinets) where indicated:

A. General: Provide standard 10 lb. multi-purpose dry chemical fire extinguishers, as follows:
   1. Surface mounted fire extinguisher - J.L. Industries Model Cosmic 10E with bracket MB846.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Installer must examine the substrates and conditions under which the fire extinguishers are to be installed, and notify the General Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.
3.02 INSTALLATION:

A. Install in locations and at mounting height to comply with governing authorities. Securely fasten to structure, square and plumb, in accordance with manufacturer's instructions.

END OF SECTION 10522
SECTION 10562 – MOBILE STORAGE SHELVING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Mechanically assisted, carriage mounted high-density mobile storage units, support rails, fabrication, and installation including leveling of support rails.

B. Related Work, Not Furnished:

1. Structural floor system capable of supporting live and dead loads required by prevailing building codes, including rolling loads of storage units to be installed.

2. Finish floor covering materials and installation when on concrete with recessed rail installation.

C. Related Sections:

1. Section 03001 - Concrete Work
2. Section 09680 - Carpeting

1.3 REFERENCES

A. American Library Association (when applicable)

1. Cantilever Bracket Type Metal Library Bookstacks; Library Technology Reports.
B. American National Standards Institute (ANSI) Standards:
   1. Applicable standards for fasteners used for assembly.

C. American Society for Testing and Materials (ASTM) Standards:
   1. Applicable standards for steel materials used for fabrication.

D. American Institute Of Steel Construction (AISC) Standards:
   1. Applicable standards for steel materials used for fabrication.

1.4 SYSTEM DESCRIPTION

A. General: The system consists of manufactured storage units mounted on manufacturer’s track-guided carriages to form a compact storage system. System design permits access to any single aisle by manually moving units until the desired aisle is opened. The carriage/rail system provides uniform carriage movement along the total length of travel, even with unbalanced loads.

B. Carriage System Design and Features: The carriage system consists of a formed structural steel frame with machined and balanced wheels riding on steel rails recessed mounted to the floor. Rails shall be types selected by the manufacturer to ensure smooth operation and self-centering of mobile storage units during travel without end play or binding. Rail types, quantities and spacing shall be selected by the manufacturer to suit installation conditions and requirements. All bearings used in the drive mechanism shall be permanently shielded and lubricated.

C. Movement Controls: Triple or single arm operating wheels with rotating hand knobs shall be provided on the accessible (drive) ends of shelf units, centered on the end panel, located 40 inches (1051MM) from the base of each unit to permit units to be moved to create a single
aisle opening. Turning the handle transmits power through chain drive to drive wheels on each carriage.

D. Drive System: The system shall be designed with a positive type mechanically-assisted drive which minimizes end play, ensures there is no play in the drive handle, and that carriages will stop without drifting.

1. System shall include a chain sprocket drive system for each movable carriage to ensure that carriages move uniformly along the total length of travel, even with unbalanced loads. All system components shall be selected to ensure a smooth, even movement along the entire carriage length. Drive system gearing shall be designed to permit 1 lb. of force applied to the drive handle to move a minimum of 4,000 lbs. of load.

2. A tensioning device shall be provided on each chain drive with provision for adjusting tension without removing end panels.

3. All bearings used in the drive mechanism shall be permanently shielded and lubricated.

E. Safety Features:

1. Color-coded visual indicators shall provide verification that carriages are in a locked or unlocked mode.

2. A single safety lock button, mounted on each operating wheel hub, will permit moving a carriage in either direction to create a new access aisle when pulled out (unlocked), or locking the carriage when pushed in.

F. Finishes:

1. Fabricated Metal Components And Assemblies: Manufacturer’s standard powder coat paint finish.

2. End Panels, Accessible Ends: Manufacturer’s standard powder coat paint finish.
1.5 PERFORMANCE REQUIREMENTS

A. Design Requirements:
   1. Limit overall height to 81 ¾”.
   2. Limit overall length to 229 15/16”.

B. Ease of Movement: Provide mechanically assisted units capable of being moved by exerting a maximum horizontal force of 5 pounds on the operating wheel.

C. Seismic Performance: Provide mobile storage units capable of withstanding the effects of earthquake movement when required by applicable building codes.

1.6 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for each type of shelving, track and installation accessory required. Include data substantiating that products to be furnished comply with requirements of the contract documents.

B. Shop Drawings: Show fabrication, assembly, and installation details including descriptions of procedures and diagrams. Show complete extent of installation layout including clearances, spacings, and relation to adjacent construction in plan, elevation, and sections. Indicate clear exit and access aisle widths; access to concealed components; assemblies, connections, attachments, reinforcement, and anchorage; and deck details, edge conditions, and extent of finish flooring within area where units are to be installed.

   1. Show installation details at non-standard conditions. Furnish floor layouts, technical and installation manuals for every unit shipment with necessary dimensions for rail layout and system configuration at the project site. Include installed weight, load criteria, furnished specialties, and accessories.
2. Provide layout, dimensions, and identification of each unit corresponding to sequence of installation and erection procedures. Specifically include the following:
   a. Location, position and configuration of tracks on all floors.
   b. Plan layouts of positions of carriages, including all required clearances.
   c. Details of shelving, indicating method and configuration of installation in carriages.

3. Provide location and details of anchorage devices to be embedded in or fastened to other construction.

4. Provide installation schedule and complete erection procedures to ensure proper installation.

C. Samples: Provide minimum 3 inch (76MM) square example of each color and texture on actual substrate for each component to remain exposed after installation.

D. Selection Samples: For initial selection of colors and textures, submit manufacturer's color charts consisting of actual product pieces, showing full range of colors and textures available.

E. Warranty: Submit draft copy of proposed warranty for review by the Architect.

F. Maintenance Data: Provide in form suitable for inclusion in maintenance manuals for mobile storage units. Data shall include operating and maintenance instructions, parts inventory listing, purchase source listing, emergency instructions, and related information.
   1. Submit manufacturer's instructions for proper maintenance materials and procedures.
   2. Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under anticipated use conditions. Include precautions against using materials and methods which may be detrimental to finishes and performance.
G. Reference List: Provide a list of recently installed mobile storage units to be visited by owner, architect, and contractor. Intent of list is to aid in verifying the suitability of manufacturer's products and comparison with materials and product specified in this section.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Engage an experienced manufacturer who is ISO 9001 certified for the design, production, installation and service of carriage mounted high-density mobile storage units and support rails. Furnish certificate attesting manufacturer’s ISO 9001 quality system registration.

B. Installer Qualifications: Engage an experienced installer who is a manufacturer's authorized representative for the specified products for installing carriages and anchoring shelving units to carriages.

1. Minimum Qualifications: 1-year experience installing systems of comparable size and complexity to specified project requirements.

2. Guaranteed 24-hour service response time.

1.8 DELIVERY, STORAGE AND HANDLING

A. Follow manufacturer’s instructions and recommendations for delivery, storage and handling requirements.

1.9 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions before fabrication. Indicate verified measurements on Shop Drawings. Coordinate fabrication and delivery to ensure no delay in progress of the Work.

B. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating mobile storage units. Coordinate construction to ensure actual dimensions correspond to established dimensions.
1.10 SEQUENCING AND SCHEDULING

A. Sequencing: Coordinate storage shelving system installation with other work to minimize possibility of damage and soiling during remainder of construction period.

B. Scheduling: Plan installation to commence after finishing operations, including painting have been completed.

C. Built-In Items: Provide components which must be built in at a time which causes no delays general progress of the Work.

D. Pre-installation Conference: Schedule and conduct conference on project site to review methods and procedures for installing mobile storage units including, but not limited to, the following:
   1. Review project conditions and levelness of flooring and other preparatory work performed under other contracts.
   2. Review and verify structural loading limitations.
   3. Recommended attendees include:
      a. Owner's Representative.
      b. Prime Contractor or representative.
      c. The Architect.
      d. Manufacturer's representative.
      e. Subcontractors or installers whose work may affect, or be affected by, the work of this section.

1.11 WARRANTY

A. Provide a written warranty, executed by Contractor, Installer, and Manufacturer, agreeing to repair or replace units which fail in materials or workmanship within the established warranty period. This warranty shall be in addition to, and not a limitation of, other
rights the Owner may have under General Conditions provisions of the Contract Documents.

B. Warrant the entire movable compact shelving installation against defects in materials and workmanship for a period of five years from date of acceptance by the Owner.

1.12 MAINTENANCE

A. Provide manufacturer’s extended maintenance agreement for 2 years, commencing on the day the standard maintenance warranty ends.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. General: Products are based upon mobile shelving system products manufactured by Spacesaver Corporation. Contingent on meeting specification requirements, other acceptable manufacturers may be included.

2.2 BASIC MATERIALS

A. General: Provide materials and quality of workmanship which meet or exceed established industry standards for products specified. Material thicknesses/gauges are manufacturer’s option unless indicated otherwise.


2.3 GROUT

A. General: Provide non-shrink, non-staining hydraulic cement compound conforming to the following requirements, based on the performance of the test specimens at room temperature and in laboratory air.

1. Linear Movement: No shrinkage while setting; maximum expansion limited to .002 inches per linear inch.
2. Compressive Strength: Based on two inch cubes made following ASTM standards, tested on a Balding-Southward machine of 60,000 pounds capacity, meet or exceed the following:

a. Age: 1 hour ---- 4,500 psi
7 days ---- 8,000 psi

2.4 MANUFACTURED COMPONENTS

A. Rails:
1. Material: ASTM/AISI Type 1035 or 1045 steel, manufacturer’s selection.
2. Capacity: 1,000 pounds per lineal foot (1385kg/M) of carriage.
4. Provide rail sections in minimum 6 foot (1.83M) lengths.
5. Rail configuration shall permit attachment to top of structural floor system with provision for leveling rails to compensate for variations in floor surface level.
6. Provide rail connections designed to provide horizontal and vertical continuity between rail sections, to gradually transfer the concentrated wheel point load to and from adjoining rail sections. Butt joints are not permitted.

B. Carriages:
1. Provide manufacturer's design movable carriages fabricated of welded or bolted steel construction. Galvanized structural components and/or riveted carriages are unacceptable.
2. Provide fixed carriages of same construction and height as the movable carriages, anchored to rails. Setting fixed shelving directly on floors is not permitted.
3. When required, provide bolted carriage splices designed to maintain proper unit alignment and weight load distribution.
4. Design carriages to allow the shelving uprights to recess and interlock into the carriages a minimum of 3/4 inch (19MM). Top mount carriages are unacceptable.

5. Provide each carriage with two wheels per rail.

C. Drive / Guide System:
1. Design: Provide drive system which prevents carriage whipping, binding and excessive wheel/rail wear under normal operation.
   a. If line shafts are used, all wheels on one side of carriage shall drive.
   b. If synchronized drives are used, a minimum of one wheel assembly driving both sides of carriage at center location required. Drive shaft shall exhibit no play or looseness over the entire length of that assembly.

2. Shafts: Solid steel rod or tube.


4. Bearing Surfaces: Provide rotating load bearing members with ball or roller bearings. Provide shafts with pillow block or flanged self-aligning type bearings.

D. Wheels:
1. Capacity: Minimum load capacity per wheel: 3200 lbs (1455kg).

2. Size: Minimum 5 inches (127MM), outside diameter drive wheels.

3. Guides: Determined by manufacturer; minimum 2 locations.

E. Face Panels:

2. Finishes: Selected from manufacturer’s standard available colors and patterns. Selected by the Architect.
F. Accessories:

1. Dual Control: Provide operating handle at each end of movable carriages.

2. Anti-Tip Devices: Provide manufacturer’s standard fixtures.

3. Waist High Carriage Locks: Provide manufacturer’s standard.


Every potential aisle shall be protected with a 3” (76 mm) high extruded aluminum safety sweep, hinged from the carriage using spring steel leaf springs, with the base edge maximum ¾” (19 mm) from the floor. The carriage(s) shall stop when depressed at any location along the leading edge of the sweep surface. Activated safety sweep shall engage an impact-absorbing friction disk brake to protect occupants, stored media and the carriage system itself via a sheathed friction cable system comprised of aircraft-grade 3/64” (1.2 mm) stainless steel core cables housed inside lined conduit. Safety sweep shall have bright, red and white safety identification tape applied full length marking its location. Safety sweep shall run the full length of both sides of each moveable carriage for full aisle coverage.

Mechanical safety sweep shall automatically reset to enable mobile system users to freely and safely back carriages away from aisle obstructions simply by reversing the direction of the rotating handle.

Safety sweep shall be operational when the carriages are not moving. Should a sweep be activated in an open aisle, the carriage with the activated sweep will not close on that aisle. Safety sweep shall automatically reset if activated and then released when the carriages are not moving.

Safety sweep shall require no electrical power or batteries to operate.
2.5 FABRICATION

A. General: Coordinate fabrication and delivery to ensure no delay in progress of the Work.

B. Wheels: Provide precision machined and balanced units with permanently shielded and lubricated bearings.

C. Carriages: Fabricate to ensure no more than 1/4 inch (6MM) maximum deviation from a true straight line. Splice and weld to ensure no permanent set or slippage in any spliced or welded joint when exposed to forces encountered in normal operating circumstances.

D. Shelving, Supports and Accessories: See individual descriptions in “Shelving” paragraphs.

2.6 FINISHES

A. Colors: Selected from manufacturer’s standard available colors. As selected by Architect.

B. Paint Finish: Provide factory applied electrostatic powder coat paint. Meet or exceed specifications of the American Library Association.

C. Laminate Finish: Provide factory applied laminate panels at locations indicated on approved shop drawings.

D. Edgings: Provide preformed edging, color-matched to unit colors selected.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine floor surfaces with Installer present for compliance with requirements for installation tolerances and other conditions affecting performance of mobile storage units.
B. Verify that building structural system is adequate for installing mobile storage units at locations indicated on approved shop drawings.

1. In new construction, ensure that recesses for rails in floors are at proper spacing and depths, with allowance for grouting.

C. Verify that intended installation locations of mobile storage units will not interfere with nor block established required exit paths or similar means of egress once units are installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to proper performance of mobile storage units, once installed.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Rails:

1. Lay out rails using full length units to the maximum extent possible. Use cut lengths only at ends to attain total length required. Locate and position properly, following dimensions indicated on approved shop drawings. Verify thickness of finished floor materials to be installed (by others) and install level 1/16 inch (0.6MM) above finished floor surfaces.

2. Verify level, allowing for a minimum 1/4 inch (6MM) of grout under high points. Position and support rails so that no movement occurs during grouting.

3. Set rails in full grout bed, completely filling any voids entire length of all rails including rail connectors. Trim up sides flush with rails to ensure proper load transfer from rail to supporting floor. Using shims in lieu of full grouting is not permitted.

4. Installation Tolerances: Do not exceed levelness of installed rails listed below:
a. Maximum Variation From True Level Within Any Module: 3/32 inch (2.4MM).

b. Maximum Variation Between Adjacent (Parallel) Rails: 1/16 inch (1.6MM), perpendicular to rail direction.

c. Maximum Variation In Height: 1/32 inch (.8MM), measured along any 10 foot (3.05M) rail length.

5. Verify rail position and level; anchor to structural floor system with anchor type and spacings indicated on approved shop drawings.

B. Shelving Units Installation:

1. General: Follow layout and details shown on approved shop drawings and manufacturer's printed installation instructions. Position units level, plumb; at proper location relative to adjoining units and related work.

2. Carriages:
   a. Place movable carriages on rails. Ensure that all wheels track properly and centering wheels are properly seated on centering rails. Fasten multiple carriage units together to form single movable base where required.
   
   b. Position fixed carriage units to align with movable units.

3. Shelving Units:
   a. Permanently fasten shelving units to fixed and movable carriages with vibration-proof fasteners.
   
   b. Stabilize shelving units following manufacturer's written instructions. Reinforce shelving units to withstand the stress of movement where required and specified.

3.3 FIELD QUALITY CONTROL

A. Verify shelving unit alignment and plumb after installation. Correct if required following manufacturer’s instructions.
B. Remove components which are chipped, scratched, or otherwise damaged and which do not match adjoining work. Replace with new matching units, installed as specified and in manner to eliminate evidence of replacement.

3.4 ADJUSTING

A. Adjust components and accessories to provide smoothly operating, visually acceptable installation.

3.5 CLEANING

A. Immediately upon completion of installation, clear components and surfaces. Remove surplus materials, rubbish and debris resulting from installation upon completion of work and leave areas of installation in neat, clean condition.

3.6 DEMONSTRATION/TRAINING

A. Schedule and conduct demonstration of installed equipment and features with Owner's personnel.

B. Schedule and conduct maintenance training with Owner's maintenance personnel. Training session should include lecture and demonstration of all maintenance and repair procedures that end user personnel would normally perform.

3.7 PROTECTION

A. Protect system against damage during remainder of construction period. Advise Owner of additional protection needed to ensure that system will be without damage or deterioration at time of substantial completion.

END OF SECTION
SECTION 10800 - TOILET ACCESSORIES

PART I - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION:

A. The extent of each type of toilet accessory is shown on the drawings.

B. The type of toilet accessories required, installed by the Contractor, include the following:

1. Soap dispenser
2. Towel dispenser
3. Toilet tissue dispensers
4. Towel Dispensers/Waste receptacle unit
5. Sanitary Napkin Disposal
6. Mirrors
7. Grab bars
8. Baby Changing Station
9. Misc. Accessories

1.03 QUALITY ASSURANCE:

A. Inserts and Anchorages:

1. Furnish inserts and anchoring devices which must be built into masonry for the installation of toilet accessories. Coordinate delivery with other work to avoid delay.

2. See masonry sections of these specifications for installation of inserts and anchorage devices.
B. Products:

1. Provide products of the same manufacturer for units exposed in the same areas, unless otherwise acceptable to the Architect.

2. Stamped names or labels on exposed faces of units will not be permitted, except where otherwise indicated.

3. Provide locks where indicated, with the same keying for each type of accessory units in the project wherever possible. Furnish two keys for each lock.

C. The specifications indicated specific products of one manufacturer to communicate design intent.

1.04 SUBMITTALS:

A. Product Data:

1. For information only, submit four (4) copies of manufacturer's technical data and installation instructions for each toilet accessory. Transmit copies of installation instructions to the Installer.

B. Samples:

1. When requested, submit full-size samples of units to Architect for review of design and operation. Acceptable samples will be returned and may be used in the work. Compliance with all other requirements is the exclusive responsibility of the Contractor.

C. Setting Drawings:

1. Provide setting drawings, templates, instructions and directions for installation of anchorage devices in other work.

PART 2 – PRODUCTS

2.01 MATERIALS:

A. Stainless Steel: AISI, Type 302/304 with polished No. 4 finish, 0.034 inch (22 gauge) minimum thickness.

B. Brass: Unleaded, flat products, ASTM B19; rods, shapes, forgings, and flat products with finished edges, ASTM B16; castings, ASTM B30.
C. Sheet Steel: Cold rolled, commercial quality, ASTM A336, 0.04 inch (20 gauge) minimum. Surface preparation and metal pretreatment as required for applied finish.

D. Galvanized Steel Sheet: ASTM A527, G60.

E. Chromium Plating: Nickel and chromium electro-deposited on base metal, ASTM B456, Type SC2.

F. Mirror Glass: Nominal 6.0mm (0.23 inch) thick, conforming to ASTM C1036, Type I, Class 1, Quality q2, and with silvering electro-plated copper coating, and protective organic coating.
   1. Provide tempered glass, unless indicated otherwise.


H. Fasteners: Screws, bolts, and other devices of same material as accessory unit, or of galvanized steel where concealed.

2.02 SOAP DISPENSER

   1. Provide with all required mounting hardware.

2.03 SANITARY NAPKIN DISPOSAL-SURFACE MOUNTED

A. Bobrick: B-270

B. ASI: 20852

2.04 TOILET TISSUE DISPENSERS

A. Kimberly Clark windows JRT JR bath tissue dispenser #09954
   Color: Smoke.

2.05 PAPER TOWEL DISPENSERS

A. Bradley: B-39619

B. ASI: 0469
2.06 MIRRORS

A. Stainless Steel Framed Mirror: Mirror shall have a one piece, Type 304 stainless steel angle frame, 3/4 inch by 3/4 inch with continuous integral stiffener on all sides and beveled front to hold frame tightly against mirror; corners shall be heliarc welded, ground and polished smooth; all exposed surfaces shall have satin finish with vertical grain. Tempered glass mirror shall be guaranteed for 15 years against silver spoilage. All edges shall be protected by plastic filler strips and the back shall be protected by full size, shock absorbing, water resistant, nonabrasive, 1/8 inch thick polyethylene padding. Galvanized steel back shall have integral hanging brackets for mounting on concealed rectangular wall hanger(s). Mirror shall be secured to hanger(s) with concealed phillips head jocking screws located in bottom of frame.

1. Manufacturers: Subject to compliance with requirements, provide mirror unit by one of the following:
   b. ASI: 0600. Provide with tempered glass.

2.07 GRAB BARS

A. Stainless Steel Type: Provide grab bars with wall thickness not less than 0.05 inch and as follows:

1. Mounting: Concealed, manufacturer's standard flanges and anchorages.

2. Clearance: 1-1/2 inch clearance between wall surface and inside face of bar.

3. Gripping Surfaces
   a. Satin finish with peened gripping surface, unless noted otherwise.

4. Heavy Duty Size: Outside diameter of 1-1/2 inches minimum.

B. Grab bar shall be constructed of Type 304 stainless steel with satin finish. Concealed mounting flanges shall be 1/8 inch thick stainless steel plate, 3-1/8 inch diameter, and each shall have 2 screw holes for attachment to wall. Flange covers shall be 22 gauge, 3-1/4 inch diameter by 1/2 inch deep, and shall snap over mounting flange to conceal mounting screws. Ends of grab bars shall pass
through concealed mounting flanges and be heliarc welded to form one structural unit. Grab bars shall comply with ADA Accessibility Guidelines for structural strength. Provide concealed anchor device or backing as specified or required in accordance with local building codes before wall is finished.

1. Manufacturers: Subject to compliance with requirements, provide grab bars by one of the following:
   a. Bobrick: B-6806.99 Series
   b. ASI: 3800P Series

   1. Horizontal:
      a. Bobrick: B-6806.99 by 36”
      b. ASI: 3800P by 36”

   2. Horizontal:
      a. Bobrick: B-6806.99 by 42”
      b. ASI: 3800P by 42”

   3. Vertical:
      a. Bobrick: B-6806.99 by 18”
      b. ASI: 3800P by 18”

2.08 BABY CHANGING STATION
A. Surface Mounted Baby Changing Station by Koala Kare Products, Model #KB200. Color to be determined.
B. Baby Changing Unit to be installed to comply with 2010 ADA Standards for accessible design and 2009 ICC A117.1.

2.09 MISCELLANEOUS ACCESSORIES
A. Trap wrap
   1. Provide trapwrap where called for in schedule.
   2. Trapwrap to be as manufactured by Brocar Products Inc. or TrueBro.

B. Mop and Broom Holders (MH): Surface mounted mop and broom holder shall be Type 304 stainless steel with satin finish. Unit shall 36 inches long with 4 spring loaded, rubber cam holders.
1. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:

   a. Bobrick: B-223-36

C. Fasteners and Anchors

1. Provide mounting kits with stainless steel screws for accessories requiring same.

2. Mounting kits shall include toggle nuts for hollow walls and expansion shields for solid walls. Provide 2 fasteners at each mounting plate.

3. Provide 12 gauge, 3 inches wide, steel concealed anchor plates with tapped holes for installation of grab bars on walls constructed with metal studs.

4. Provide concealed anchors for installation of grab bars on solid walls. Anchor assembly shall consist of tapped 12 gauge anchor plate, 10 gauge back plate, and 3/8 inch diameter thru-wall bolt.

PART 3 - EXECUTION

3.01 INSPECTION:

   A. Installer must examine the areas and conditions under which toilet accessories are to be installed and notify the General Contractor in writing, of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 INSTALLATION:

   A. Use concealed fastenings wherever possible.

   B. Provide anchors, bolts and other necessary anchorages and attach accessories securely to walls and partitions in locations as shown or directed.

   C. Install concealed mounting devices and fasteners fabricated of the same materials as the accessories, or of galvanized steel, as recommended by manufacturer.
D. Install exposed mounting devices and fasteners finished to match the accessories.

E. Provide theft-resistant fasteners for all accessory mountings.

F. Secure toilet room accessories in accordance with the manufacturer's instructions for each item and each type of substrate construction.

G. Schedule:
   1. Women’s Toilet Rooms 164, 120, 123
      a. 1 ¼” dia. grab bars, 36”, 42” & 18” lengths (1 ea at each H.C. Toilet)
      b. Toilet Tissue Dispensers (1) per water closet
      c. Mirror size as shown on drawings.
      d. Combination Paper Towel Dispenser/Waste Disposal Units (1) per room
      e. Soap dispensers (1) per lav
      f. Trap Wrap (1) per lav
      g. Sanitary Napkin Disposals (1) per water closet
      h. Baby Changing Station
   2. Men’s Toilet Room 122, 121, 162
      a. 1 ¼” dia. grab bars, 36”, 42” & 18” lengths (1 ea per H.C. Toilet)
      b. Toilet Tissue Dispensers (1) per water closet
      c. Mirror Size as shown on drawings.
      d. Combination Paper Towel Dispenser/Waste Disposal Units (1) per room.
      e. Soap dispenser (1) per lav
      f. Trap Wrap (1) per lav
      g. Baby Changing Station
3. Break Room 118
   a. Soap Dispenser (1) per sink
   b. Paper Towel Dispenser (1) per sink
4. Unisex Toilet Rooms 108
   a. 1 ½" dia. grab bars, 36", 42" & 18" lengths (1 ea per H.C. Toilet)
   b. Toilet Tissue Dispensers (1) per water closet
   c. Mirror Size as shown on drawings.
   d. Combination Paper Towel Dispenser/Waste Disposal Units (1) per room.
   e. Soap dispenser (1) per lav
   f. Trap Wrap (1) per lav
5. Private Toilet Rooms 125, 133, 160
   a. Toilet Tissue Dispensers (1) per water closet
   b. Mirror Size as shown on drawings.
   c. Combination Paper Towel Dispenser/Waste Disposal Units (1) per room.
   d. Soap dispenser (1) per lav
   e. Trap Wrap (1) per lav
6. Janitor Closets 119, 163
   a. Mop & Broom Holder

END OF SECTION 10800
PART 1 - GENERAL

1.01 RELATED DOCUMENTS:

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:

A. The extent of miscellaneous specialties is as shown on the drawings or schedules and includes the following:

1. Display/poster case
2. Dishwasher
3. Court Benches (pews)
4. Exterior Drop Box
5. Reception pass-through window system
6. Detention Style Wall Mounted Swivel Stool

1.03 SUBMITTALS:

A. Product Data:

1. Submit two (2) copies of manufacturer's specifications and installation instructions for each type of specialty required. Indicate by transmittal that copy of each instruction has been distributed to the Installer.

B. Samples:

1. Submit three (3) samples of each color and finish of exposed materials and accessories required for each specialty. Architect's review of samples will be for color and texture only. Compliance with all other requirements is the exclusive responsibility of the Contractor.

C. Shop Drawings:

1. Submit shop drawings for fabrication and erection of specialties, including plans, elevations and large scale details, shop anchorages and accessory items. Provide location template drawings for items supported or anchored to permanent construction.
PART 2 - PRODUCTS

2.01  PREFABRICATED PRODUCTS:

A. Surface Mount Display/Poster Case:

1. Provide model 307 (4’h x 6’w) as manufactured by Claridge.
   a. Frame shall be 3” clear anodized aluminum frame of 6063T5 alloy. Frame shall have safety wrapped mitered corners.
   b. Hinge shall be continuous piano type hinge.
   c. Provide with tackable back panel. Color selected by Architect from manufacturers standard color range.
   d. Doors shall be of ¼” temp. glass.
   e. Provide (3) per building. Locations as shown on Drawings.

B. Under Counter Dishwasher:

1. Provide ADA Under Counter Dishwashers as shown on drawings. Quantity: As indicated on drawings.
2. Finish to be black on stainless steel with stainless steel interior 24” wide x 24” deep.
3. Provide models by:
   a. GE #GLDA696PSS
   b. Whirlpool #GU3100XTVS

C. Court Benches:

1. Provide all wood court (pew) benches as manufactured by Sauder Manufacturing.
   b. End: TBD
   c. Wood Species: rift cut white oak.
   d. Finish: TBD
   e. Size: 16” depth by length indicated on drawings.
   f. Seat Cushion Fabric: TBD

D. Drop Box:

1. WDS – 160 Protex Wall Drop Box w/adjustable chute
E. Reception Pass Through Window: (Office 107)

1. Double window – aluminum flexible track system as manufactured by Space Plus, Chicago, IL 1-312-494-9494.
   a. Provide with flush slide belt.
   b. Provide security glass SG-1 in frame (Refer to Spec Section 08805 “Security Glazing”).

F. Wall Mounted Detention Style Swivel Stool:

1. American Jail Products, 4 Van Buren Street, Troy, NY 12180, Phone: 518-271-6560.
   a. Model #231 wall mounted swivel stool
      i. 12” dia. seat formed from 11 ga. stainless steel with a 6” square x 3/16” thick back plate with 1¼” turned down all around.
      ii. Wall plate 7” x 11” x ⅛” welded to pivot arm assembly.
      iii. Support Arm: 7 gauge mild steel bent plate.

G. Knox Box:

1. Surface mounted with hinged door; 3200 Series, provide knox box decal. Mount between 5-6’ above finished grade in location as shown on drawings.

PART 3 - EXECUTION

3.01 INSPECTION:

A. Installer must examine the substrates and conditions under which the specialties are to be installed, and notify the General Contractor and Architect in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 INSTALLATION:

A. In addition to the requirements of these specifications, comply with manufacturer's instructions and recommendations for preparation of substrate, installation of anchors, and application of specialties. Coordinate with work of other trades for application of inserts of other integral equipment items.
B. Install at the locations shown or scheduled, securely mounted with concealed fasteners, unless otherwise shown. Attach to substrates in accordance with the manufacturer's instructions, unless otherwise shown.

C. Install level, plumb and at the proper height. Cooperate with other trades for installation in finish surface. Repair or replace damaged units as directed by the Architect.

END OF SECTION 10999
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK

A. Security hollow metal doors, and steel frames for doors, side lites, borrowed lites and related openings.

B. Metal trim and closures used in conjunction with security hollow metal work.

1.03 RELATED WORK SPECIFIED ELSEWHERE:

A. Section 08710 – Finish Hardware

B. Section 08805 – Security Glazing

1.04 QUALITY ASSURANCE:

A. Security Hollow Metal (SHM) Standard: Comply with ANSI/NAAMM HMMA 863.04 except as otherwise indicated.

B. Provide Security Hollow Metal Work manufactured by a single firm specializing in the production of this type of work. Doors and frames shall come from the same manufacturer.

C. Welders shall be currently qualified under AWS B2.1 to perform the type of work required.

D. All welding requires complete penetration and fusion welds must remove parent materials when tested to failure. Refer to welding standards as defined in AWS D1.3 and RWMA, Resistance Welding Manual.

E. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated or required, provide fire-rated door and frame assemblies that comply with NFPA 80 and have been tested, listed, and labeled in accordance with ASTM E 152 by a nationally recognized independent testing and inspection agency acceptable to authorities having jurisdiction. Where fire-rated door or frame assemblies are indicated or required but essential detention features such as security glazing or accessories do not meet the criteria for
labeling, manufacturer shall provide equivalent construction and “Certificate of Equivalence” along with specific documentation of why each door or frame assembly does not meet labeling criteria in the shop drawing submittal.

F. Equivalent Construction: Where fire-rated door assemblies call for equivalent construction, manufacturer shall provide specific documentation of why each door assembly does not meet labeling criteria as well as documentation describing equivalent construction and certification that doors called for have been provided with equivalent construction.

G. The Contractor shall designate, in writing, a quality control representative for installation of all frames. This organization shall be reviewed at the Security Coordination Meeting. The quality control representative shall personally check and verify each frame opening for tolerances specified. The tabular verification for masonry installation shall indicate check at setting, masonry half up and masonry completed around frame. The Contractor shall verify the final check. The frames will not be accepted unless verifications have been properly submitted and reviewed by Architect for Contract compliance. The frame shall be installed in strict accordance with tolerances for plumbness, squareness, alignment, and twist as defined in NAAMM Hollow Metal Manual, latest publication. The Contractor shall be responsible for providing quality control of the installation.

H. Security Hollow Metal Manufacturers shall have at least 5 years of experience and 3 jobs of equal complexity which have been completed and occupied within the last 5 years. References shall include, but not be limited to, the following:

1. Name and location of project, date of occupancy and Contract value.
2. Name, address and telephone number of the Owner’s operations supervisor, Owner’s maintenance supervisor, Architect, and General Contractor. Specific references regarding manufacturer’s ability to coordinate with Security hardware installation are required.
3. Manufacturer shall provide documentation of labeling ability as required on specific assemblies.
4. Manufacturer shall provide documentation of any and all pending litigation as well as an audited financial statement for the most recently completed fiscal year.
5. Manufacturer shall provide actual samples as well as any other information requested by the Architect.
I. Cut and form joints to hairline measurements. Make all exposed joints smooth and invisible. Grind all exposed welds smooth and flush. Form all arrises sharp and true. Miter all face joints.

1.05 SUBMITTALS

A. Manufacturer's Data: Submit manufacturer’s data for fabrication and installation instructions.

B. Shop Drawings: Submit shop drawings for the fabrication and installation of security hollow metal work. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, locations and installation requirements of finish hardware and reinforcements, and details of joints and connections.

C. Provide a schedule of doors and frames using same reference numbers for details and openings as those on the contract drawings.

D. Submit to Architect an independent testing laboratory report, certifying minimum performance data as stated above for a typical flush security door panel. Test report shall indicate all gauges of component parts and shall describe construction methods.

E. Submit samples of the security doors and frames, including typical construction of frame joinery, lock edges, and reinforcements, door construction at top, bottom core and welds, and reinforcements at hinge.

1.06 DELIVERY, STORAGE AND HANDLING:

A. Deliver security hollow metal work cartoned or crated to provide protection during transit and job storage.

B. Inspect security hollow metal work upon delivery for damage. Minor damages may be repaired provided the finish items are equal in all respects to new work and acceptable to the Architect; otherwise, remove and replace damaged items as directed.

C. Store security hollow metal and steel work at the building site under cover. Place units on at least 4” high wood sills or on floors in a manner that will prevent rust and damage. Avoid the use of non-vented plastic or canvas shelters which could create a humidity chamber. Provide a ¼” space between stacked doors and panels to promote air circulation.
PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide security hollow doors and frames by one of the following:
   1. Habersham Metal Products Co., Cornelia, GA
   2. Trussbilt, St. Paul, MN
   3. Overly Manufacturing Co.

2.02 SECURITY HOLLOW METAL FRAMES

A. Construction: Frames shall be combination type with integral trim fabricated of cold rolled, or hot rolled, pickled and oiled steel sheets with clean, smooth surfaces. Joints shall be full welded unit type construction with contract edges closed tight and welds on exposed surfaces depressed smooth and flush. Fabricate molded members straight and true, with corner joints well formed and in true alignment and fastenings concealed where practicable. Frames for exterior openings shall be made of commercial grade steel conforming to ASTM A366. Frames for interior openings shall be either commercial grade cold rolled steel conforming to ASTM A366 or commercial grade hot rolled and pickled steel conforming to ASTM A569. Metal thickness for all frames shall be 12 gauge unless otherwise indicated in the schedule. Frames shall have fully mitered joints, excluding stops (stops shall be buttered or mitered), and shall be continuously welded (stitch welding is not equal) inside the miter across the full depth and width of the frame. Jambs, head, and sill shall be prepared to be firmly secured to walls and fully grouted. Mullions shall be provided with additional reinforcing as required or specified herein and shall be blocked off to prevent spillage of mortar or grout.

B. Galvanizing: All exterior frames, and any other frames specifically designated in the schedule shall be galvanized. Frames specified as galvanized shall be zinc coated carbon steel in accordance with ASTM A526/A, 526M, G60 or A60 zinc coating, mill phosphatized.

C. Frames for Multiple or Special Openings: Shall have mullion and/or rail members which are closed tubular shapes, having no visible seams or joints on the faces. All joints between faces of abutting members shall be securely welded and finished smooth. Jambs, head, and sill shall be prepared to be firmly secured to walls and fully grouted. Mullions shall be provided with additional reinforcing as required or specified herein and shall be blocked off to prevent spillage of mortar or grout.
D. Field Splicing: Frames shall be shipped as a complete unit where possible. When shipping limitations so dictate, frames for large openings shall be fabricated in smaller sections and designed for splicing in the field. Factory prepared splices shall be field assembled and welded by the installer. Exposed faces of all welded joints shall be dressed smooth. Components of frames shall be sheared, stamped, drilled or cut with a saw. Burning with a torch is not acceptable in the field or in the shop.

E. Reinforcing: Frames shall be mortised, reinforced, drilled and tapped at the factory for templated mortised hardware in accordance with the approved hardware schedules and templates provided by the subcontractor for that section. Where surface mounted hardware is to be applied, frames shall have reinforcing plates installed and shall be drilled and taped in the field by the hardware installer.

1. Hinges: For mortise butts, provide a minimum 7 gauge x 1 ¼” x 10” long reinforcing plate, offset at each hinge location and factory drilled and tapped. A 12 gauge by 1 ¼” x 1 ¼” x 2” long angle reinforcement shall be welded in place between the center of the reinforcement and the inside trim face of the frame to prevent deformation of the hinge reinforcement under door load. A mortar guard shall be welded in place on the back of the reinforcement, and filled with a urethane foam or otherwise made grout tight through proven performance, to prevent grout from entering the screw holes prior to hardware installation. For continuous hinges, provide ¼” thick piece of styrofoam backing, full height of door, behind hinge side of frame to protect field drills.

2. Strike Plate: Shall have a 7 gauge reinforcement plate behind it that is securely welded to the frame 1” on four sides. The lock bolt shall engage in a punched opening in the reinforcing that matches the cut-out in the strike plate. Protect cut out with a pressed steel mortar guard on the inside of the frame.

3. Lock, push button, and any other cutouts: Shall be reinforced and in accordance with the recommendation of the hardware manufacturer. Reinforcements shall be not less than 7 gauge steel. All cutouts shall be protected with pressed steel mortar guards on the inside of the frame. Holes for silencers shall be protected with mortar guards. The push button shall have no exposed fasteners and shall be recessed in the frame with a punched opening for the button only. The push button shall be accessible from the lock pocket.
F. Floor Anchors: Where required in the Contract Documents, shall be formed or not less than 12 gauge steel and shall be securely welded at the bottom of each jamb. Adjustable floor anchors shall extend down to below the finish floor and provide not less than 2” height adjustment.

G. Anchors in Masonry:
   1. Jamb Anchors: Shall be adjustable anchors for the strap and stirrup type made from the same gauge steel as frame. Strap shall be no less than 2” x 10” in size, corrugated and/or perforated. The number of anchors provided on each jamb shall be as follows:
      a. Frames up to 7’-6” height – 4 anchors evenly spaced
      b. Frames from 7’-6” to 8’-0” height – 5 anchors evenly spaced
      c. Frames over 8’-0” height – 1 anchor @ 16” o.c.
   2. Loose “T” anchors: Shall be provided at 16” o.c. at the heads of all masonry openings greater than 4’-0”. “T” anchors shall be made from the same gauge steel as frame and shall be perforated to engage rebar in masonry lintels.

H. Strap Bracing: Shall be 1 ½” wide and of the same gauge material as the frame in which it occurs. It shall be spot welded inside the throat of the frame. Locate As shown on the Drawings and required to prevent deformation of frame and provide additional anchoring when frame is grouted.

I. Stiffeners: All frames shall be provided with steel spreader angles, temporarily attached to the bottom of both jambs, one on each side of the opening to serve as a brace during shipping and handling. The steel spreaders shall be removed by the Contractor prior to setting frames.

J. Removable Security Glazing Stops: In addition to meeting performance test requirements, the removable glazing stop shall consist of a 1 ¼” x 1 ¼” 10 gauge angle securely fastened to the frame using machine screws ¼-28 or ¼-20, Grade #8, 6 inches on center, a maximum of 3 inches from the corners. All exposed screw heads shall be round, pan, or oval, torx drive with center pin. The finished glass stop shall be tight fitting and mitered or notched to achieve a tight seam at the corner joints. Mortar guards covering all glazing stop screws shall be installed on all frames. Glazing stop shall provide for a minimum 1” glass engagement.
K. Electrical Conduit: EMT shall be provided in mullions or other inaccessible locations of the frame to accommodate requirements of security Hardware Sets, Electronic Security items, and/or other items as shown on the Drawings or the schedules. Flexible conduit may be provided at locations with special installation requirements. All factory installed wireways should utilize permanent type plastic screw in “Chafe” bushings. Where wireways are created on assembly in the field, screw in “chafe” bushings shall also be used.

L. Grout Access Holes: Shall be provided in all frames where access to the top of the frame will be obstructed during installation to prevent grouting from the top. The hole shall consist of a 1 ¼” x 1 ¼” cut out in the frame. A 1 ¾” x 3” 12 gauge back up plate with a 1 1/8” diameter circular cut-out shall be welded behind the frame cut-out. A 1 3/16” x 1 3/16” 12 gauge closer piece shall be provided with the frame for field welding after frame has been grouted solid. Installer shall field weld closer pieces. Field welds shall be cleaned, dressed smooth and primed so that location of grout access holes is not apparent after finishing. Location of grout access holes shall be as recommended by the manufacturer and Installer to achieve the requirements for grouting all heads, jambs and sill solid and shall be clearly shown on the shop drawings for review.

M. Device Cut-outs: Devices shall be recessed in all frames where they are shown on the frame elevations or called out in the schedule. Face plates shall be secured with ¼-20 torx type security screws. Device shall be protected in a mortar box which also prevents access to lock or locking devices. Conduit shall be separate from any locking or other monitoring device conduit. Templates shall be provided by the Electronic Security Contractor.

N. Electrical (and/or Electronic Security) Pocket, Cut-out and Closer Plate: Electrical devices shall be recessed in all frames where indicated on the frame elevation or called out in the schedule. Security closer plate, prepped to receive a nylon face plate mounted to it, shall be provided and the pocket shall be protected from grout. Cut-out shall be an 8” x 8” opening. A 9” x 9” 7 gauge back up place with a 6” x 6” cut-out in its center shall be welded to the back of the cut-out in the frame. An 8” x 8” 12 gauge closer plate shall be provided with the frame. The closer plate shall be prepped to receive the electrical data access port or receptacle, outlet box and nylon face plate specified in Division 16 and 17. The Division 16 and Division 17
Contractors shall provide templates and physical samples of the device(s) to be used. Any exposed fasteners shall be torx type security screws with center pins. Security closer plate and backup plate shall be drilled and tapped to receive four (4) ¼-20 F.H. torx type security screws with center pins. Security closer plate cut-outs and locations of receptacles shall be coordinated with the Division 16 and Division 17 Contracts and shall be clearly shown on the Shop Drawings for review.

O. Finish: After fabrication, all tool marks and surface imperfection shall be removed. Galvanize frames shall have all welds and ground areas touched up to match original galvanized material. Exposed faces of all welded joints shall be dressed smooth. Frames shall receive appropriate preparation to insure maximum adhesion and shall be coated on all surfaces with a shop coat of rust inhibitive primer which is fully cured prior to shipment and meets or exceeds test requirements specified.

1. Shop Primer for Ferrous Metal: Alkyd or Modified Alkyd Rust Inhibitive primer with VOC content not exceeding 340 grams/litre or 2.8 lbs/gallon, lead and chromate free, recommended by manufacturer for exterior exposure on iron or steel substrates and compatible with alkyd, latex and acrylic top coats.

2. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, having VOC content not exceeding 340 grams/litre or 2.8 lbs/gallon and complying with SSPC-Paint-20 except containing no lead or chromate.

2.03 SECURITY HOLLOW METAL DOORS

A. General: Doors shall be of type and size as schedule, fabricated of cold rolled, pickled and oiled stretcher leveled steel sheets with clean smooth surfaces. Finished work shall be rigid, neat in appearance, and free of defects. Form molded members shall be straight and true, with joints coped or mitered, well formed, and in true alignment. Welded joints on exposed surfaces shall be dresses smooth, to be invisible.

1. All doors shall be custom made full flush design, internally reinforced, sound deadened and insulated. Doors shall receive security hardware of the types and sizes shown on the approved Shop Drawings and schedules.
2. Door thickness shall be 2" unless otherwise indicated in the schedule. Manufacturer shall coordinate frame dimensions with the thickness of the doors.

B. Galvanizing: All exterior doors, and other doors specifically designated in the schedule are to be galvanized. Doors specified as galvanized shall be zinc coated carbon steel sheet in accordance with ASTM A526, G60 zinc coating, mill phosphatized.

C. Construction: Doors shall have mild steel face sheets continuously welded on edges and finished smooth so that there are no visible seams. The door shall be stiffened by continuous vertical formed steel Sections which, upon assembly, shall span the full thickness of the interior space between door faces. The stiffener shall be 16 gauge minimum, spaced so that the vertical interior webs shall be no more than 4” o.c. and securely fastened to both face sheets by spotwelds spaced a maximum of 3” o.c. vertically. Spaces between stiffeners shall be filled with mineral rock wool batt type material of three pound density. Vertical stiffeners shall be no more than 3” from edge of door and shall be full length between top and bottom edge channels. Cope at reinforcement plates.

D. Edge Construction: Both vertical door edges shall be beveled 1/8” in 2” and shall be reinforced by continuous steel channels, not less than 10 gauge, extending the full length of the door welded (3” on center maximum) inside both faces. Top and bottom door edges shall be closed with continuous recessed 10 gauge channels extending the full width of the door and welded (3” on center maximum) inside both faces and continuously welded to the vertical door edge channels to form a continuous single perimeter frame inside the door with no cut-outs. At doors with jamb mounted locks, provide a punched opening only to receive the lock bolt (and roller bolt where required). Do not cut the edge channel to receive the entire lock strike or keeper.

E. Closer Channel: The top and bottom recessed channel shall be fitted with an additional flush closer channel of not less than 16 gauge. The flush closer channel shall be welder in place at the corners and at the center. Installation of the closer channel using screws, security or otherwise, is not acceptable. The edge channel and flush closer channel shall be installed so that they are permanent and non-removable.
F. Door Faces: Shall be of commercial quality leveled cold rolled steel conforming to ASTM A366 or hot rolled pickled and oiled steel conforming to ASTM A569 and shall be free of scale, pitting or other surface defects. Face sheet shall be 12 gauge unless otherwise indicated in the schedule.

G. Appearance: All doors shall be strong, rigid and neat in appearance, free from warp, wind or buckle. All bends shall be true and straight and of minimum radius based on the gauge on metal used.

H. Hardware Installation: Door edges shall be mortised and accurately cut, reinforced, drilled and tapped to receive templated mortised hardware in accordance with the approved hardware schedule and the hardware manufacturer’s recommendations for the proper installation of all hardware and accessories. Where surface mounted hardware is to be applied, the manufacturer shall provide reinforcement plates only, drilling and tapping shall be done in the field by the hardware installer.

I. Removable Security Glazing Stops: In addition to meeting performance test requirements, the removable glazing stop shall consist of a 1 ¼” x 1 ¼” 10 gauge angle securely fastened to the frame using machine screws ¼-28 or ¼-20, Grade #8, 6 inches on center, a minimum of 3 inches from the corners. All exposed screw heads shall be round, pan, or oval, torx drive with center pin. The finished glass stop shall be tight fitting and mitered or notched to achieve a tight seam at the corner joints. Glazing stop shall provide for a minimum 1” glass engagement.

J. Finish: After fabrication, all tool marks and surface blemishes shall be filled and sanded as required to make both faces and both vertical edges smooth and free of irregularities. Galvanized doors shall have all welds and ground areas touched up to match original galvanized material. After appropriate preparation to insure maximum adhesion, all exposed surfaces shall receive a shop coat of rust inhibitive primer which is full cured prior to shipment and meets or exceeds test requirements specified.

1. Shop Primer for Ferrous Metal: Alkyd or Modified Alkyd Rust Inhibitive primer with VOC content not exceeding 340 grams/litre or 2.8 lbs/gallon, lead and chromate free, recommended by
manufacturer for exterior exposure on iron or steel substrates and compatible with alkyd, latex and acrylic top coats.

2. Galvanizing Repair Paint: High zinc dust content paint for regalvanizing welds in galvanized steel, with dry film containing not less than 94 percent zinc dust by weight, having VOC content not exceeding 340 grams/litre or 2.8 lbs/gallon and complying with SSPC-Paint-20 except containing no lead or chromate.

3. All exposed surfaces shall receive two shop coats of a rust inhibitive primer which meets or exceeds ASTM B 117 salt spray for 150 hours, and ASTM D 1735 water fog test for organic coatings for 200 hours, and which is full cured prior to shipment.

PART 3 – EXECUTION

3.01 INSTALLATION:

A. Install security hollow metal units and accessories in accordance with the final shop drawings, manufacturer’s data, and as herein specified.

B. Set all work accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces and spreaders leaving surfaces smooth and undamaged.

C. Fit exposed connections accurately together to form tight hairline joints. Weld connections which are not to be left as exposed joints, but cannot be shop welded because of shipping size limitations. Grind exposed joints smooth and touch-up shop paint coat. Do not weld, cut or abrade the surfaces of exterior units which have been hot-dip galvanized after fabrication, and are intended for bolted or screwed field connections.

D. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

E. Make field splices in frames as detailed on final shop drawings, welded and finished to match factory work.
F. Door Installation:

1. Fit security hollow metal doors accurately in their respective frames, with the following clearances:
   a. Jambs and Head: 1/8”
   b. Meeting edges, pairs of doors: 1/8”
   c. Bottom: 3/4”, where no threshold.
   d. Bottom: Over threshold 1/4”

3.02 ADJUST AND CLEAN:

A. Final Adjustments: Check and re-adjust operating finish hardware items in security hollow metal work just prior to final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including doors or frames which are warped, bowed or otherwise unacceptable.

B. Prime Coat Touch-up: Immediately after erection, sand smooth any rusted or damaged areas of prime coat and apply touch-up of compatible air-drying primer.

END OF SECTION 11193
PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 WORK INCLUDED:

A. Security mirrors
B. Security barrier free grab bars
C. Bench with cuff rings

1.03 SUBMITTALS

A. Manufacturers Data: Submit copies of manufacturer's specifications, anchoring details and installation instructions for items specified. Indicated by transmittal that installation instructions have been distributed to the Installer.

B. Shop Drawings: Submit shop drawings for the fabrication and installation of all miscellaneous security equipment and furnishings and other pertinent information to fully describe compliance with the drawings and specifications. Include details, elevations, details of construction, location and installation requirements of reinforcements and details of joints, connections and installation procedures, hardware and such schedules as necessary.

1.04 DELIVERY, STORAGE AND HANDLING:

A. Deliver furniture cartoned or crated to provide protection during transit and job storage. Protect stainless steel on exposed surfaces from damage by application of strippable protective covering prior to shipment.
B. Inspect items upon delivery for damage. Minor damages may be repaired provided the finish items are equal in all respects to new work and acceptable to the Architect, otherwise the Owner will remove and replace damaged items as directed.

C. Preassemble items at shop to greatest extent possible to minimize mechanical joints, splicing and field assembly.

D. Transport, and store miscellaneous security items in a manner that will prevent rusting, distortion, or damage. Replace damaged material. Store clear of the ground and protect from water and the elements. Wrap and carton or crate to adequately protect during shipment and storage at jobsite.

1.05 JOB CONDITIONS

A. Contractor must examine the substrate and conditions under which the work is to be installed and notify the General Contractor in writing of any conditions detrimental to the proper and timely completion of the work.

PART 2 - PRODUCTS

2.01 MATERIALS:

A. Cold Rolled Steel Sheets: ASTM A366

B. Stainless steel: AISI Type 302/304

C. Steel Pipe: ASTM A53, Grade A, Standard weight Schedule 40

D. Shop-applied Paint: For steel surfaces, use rust-inhibitive primer, either air-drying or baking, suitable as a base for specified finish paints.

E. Fasteners: Slotted twin head machine screws. Slotted head shall be twisted off after installation.

F. Embeds: Fabricate and deliver embedded anchorage devices and weld plates to be built into masonry walls or cast into concrete floors, for all items of work specified herein. Where embedded in floors or exterior walls, provide plates and anchors hot dip galvanized after fabrication.
2.02 MISCELLANEOUS SECURITY EQUIPMENT

A. Mirror: Provide 24” x 36” mirror with frame and mounting equal to Bradley SA03-2. Provide one for each holding cell.

B. Grab Bars: Provide bars equal to Bradley SA70-36, SA70-42 and SA70-18. Provide security grab bars at the H.C. holding cell as indicated on drawings.

2.03 HOLDING CELL BENCH WITH CUFF RINGS

A. Holding Cell bench with cuff rings

1. Provide and install (2) 48” and (1) 60” wall bench as manufactured by Norix Group, West Chicago, IL 800-234-4900.

2. Fabrication & Material:
   a. Cut, formed and welded steel. Cuff rings welded to frame. 12 gauge steel seating with 7 gauge brackets and 3/8” dia. steel cuff rings with powder coat finish. Made in USA.
   b. Product tested to 750 static load.

3. Provide Model 1BF48 – 48” floor bench and 1BF60 – 60” where indicated on drawings.


5. Install with all required anchors to secure unit to floor.

2.04 FABRICATION OF SECURITY FURNISHINGS:

A. Fabricate items to be rigid, neat in appearance and free of defects, warp or buckle.

B. Use materials of size and thickness shown or, if not shown, of required size and thickness to produce strength and durability in finished product. Work to dimensions shown or accepted on shop drawings, using proven details of fabrication and support.

C. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges. Ease exposed edges to a radius of approximately 1/32” unless otherwise shown. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Weld corners and seams continuously, complying with AWS
recommendations. At exposed connections, grind exposed welds smooth and flush to match and blend with adjoining surfaces.

E. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners wherever possible. Use exposed fasteners of type shown or, if not shown, twin headed, twist off (countersunk) screws.

F. Provide for anchorage of type shown, coordinated with supporting structure. Fabricate and space anchoring devices to provide adequate support for intended use.

2.05 SHOP PAINTING

A. Clean, treat and paint exposed surfaces of security furnishing items.

B. Clean steel surfaces of mill scale, rust, oil, grease, dirt and other foreign materials before the application of the shop coat of paint.

C. Apply pretreatment to cleaned metal surfaces, using cold phosphate solution (SSPC-PT2), hot phosphate solution (SSPC-PT4) or basic zinc chromate-vinyl butyral solution (SSPC-PT3).

D. Apply shop coat of prime paint within time limits recommended by pretreatment manufacturer. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 2.0 mils.

PART 3 - EXECUTION

3.01 INSPECTION

A. Contractor must examine the areas and conditions under which the work is to be installed. Notify the General Contractor in writing of conditions detrimental to the proper and timely completion of the work.

3.02 INSTALLATION

A. All materials and equipment shall be securely anchored, rigid, true to line, plumb, or level, and square. Uniformity of quality and appearance shall prevail throughout the work.

B. All members and equipment which are subject to damage
by inmates, or to vibration or racking of any kind shall be anchored and/or connected to eliminate damage.

C. Provide theft-resistant fasteners for all exposed fastening devices.

D. Locate and place security furnishings plumb, level and in proper alignment with adjacent work.

E. Field Welding: Comply with AWS Code for procedures of manual shielded metal-arc welding, appearance and quality of welds made, and methods used in correcting welding work.

F. Touch-up Painting: Immediately after installation clean field welds, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting. Apply by brush or spray to provide a minimum dry film thickness of 2.0 mils.

END OF SECTION 11195
PART 1 - GENERAL

1.01 General Provisions

A. Attention is directed to Division 0, Bidding and Contract Requirements and to Division 1 General Requirements which are hereby made a part of this Specification. Refer to other sections, divisions, and schedules for work in connection with this section.

1.02 Intent

A. The intent of this specification is to establish minimum performance and quality criteria consistent with preestablished standards of design and function. Casework not meeting these minimum requirements will be unacceptable.

B. The casework contractor shall be held in strict compliance with any specific materials, finishes, construction details and hardware that are specified herein. Bids proposing to supply casework not meeting these requirements will be rejected.

1.03 Work Included

A. Furnish, deliver, and install to Owner's and Architect's satisfaction, all prefabricated plastic laminate casework as shown on drawings, schedules and equipment lists.

B. Furnish and install all fillers, scribes, finished ends, finished backs, work surfaces/backsplashes, and cutouts required to provide a complete and finished project. Plastic laminate work surfaces shall include backer sheet.

C. Provide sinks and fittings, electrical outlets and fixtures when specifically stated as being part of this contract.

D. Provide locks on all cabinets capable of locking unless noted otherwise. All cabinets are to be keyed alike per room. All locks are to be masterkeyable to room doors.
E. Installer shall coordinate with Owner’s M/E/P Contractor, connection, and testing of all sinks, fittings, electrical fixtures; coordinating all rough-ins: mechanical piping, electrical runs, and connections required for a complete project.

F. Blocking, framing, and reinforcement in walls, ceilings, and floors for anchoring of cabinets and trim.

1.05 QUALIFICATIONS

A. Plastic laminate casework shall be as manufactured by Stevens Cabinet Co. Division of Stevens Industries Inc., Teutopolis, Illinois. Products and catalog numbers are from Stevens catalog and are used as basis for identification, configuration, size and quality.

B. Other pre-approved manufacturers are as follows:
   • TMI Systems Design Corp. Dickinson, North Dakota
   • Case Systems Inc., Midland, Michigan
   • LSI Corporation of America, Inc., Minneapolis, Minnesota
   • Wood Metal Industries, Selinsgrove, PA
   • Strata Design, Inc., Traverse City, MI

C. Casework of other manufacturers will be considered for approval providing written request is received at least ten (10) days prior to announced bid date and approved by addendum. Bidder shall state in writing any deviations from requirements and specifications. The casework shall conform to configuration, arrangement, design, material quality, joinery, panel thickness, and surfacing of that specified and shown on drawings.

D. Manufacturers requesting approval shall submit samples with Cut-A-Ways showing cabinet construction, joinery, drawer and door construction, hardware, and materials; along with catalogs and specification in order that accurate evaluations can be made. Samples may be impounded for the duration of contract to insure construction specification compliance.
1.06 SUBMITTALS

A. Shop drawings shall be submitted for approval within thirty (30) days after formal notification of award of contract. Drawings shall consist of floor plans indicating arrangement and relation to electrical, data technology and adjacent work and equipment, and complete elevations of casework. Centerline of service requirements shall be noted for use by other trades. A schedule of all sinks, fittings, and accessories that are part of this contract shall be provided.

B. Color samples shall be submitted for selection and coordination at time of contract award. Samples of actual material and color shall be available as required.

C. Additional catalog cuts, details and samples as requested by Architect for evaluation and coordination.

D. Physical sample must be approved prior to fabrication.

1.07 PRODUCT DELIVERY AND STORAGE

A. Protect cabinet and countertops during transit, delivery, storage and handling to prevent damage, soiling and deterioration.

B. Store cabinets and countertops at project site installation and storage areas with similar ambient conditions as final installation. Storage areas must be kept dry, heated with low relative humidity and away from construction work such as painting, wet work, grinding and similar operations.

1.08 WARRANTY

A. Casework manufacturer shall provide lifetime guarantee and limited warranty to the original Owner against defective material and fabrication for as long as they own the product – this is a warranty of replacement and repair only, the manufacturer will correct defects in material and/or fabrication without additional cost.

B. Accessory equipment (sinks, fittings etc.) shall be warranted by appropriate manufacturer's guarantee.
PART 2 - PRODUCTS

2.01 CORE MATERIAL

A. Cabinet components having particle board core material shall be of a minimum 45 lb. density, M-2 industrial grade. The particle board used shall have been tested under ANSI A208.1 1993 standards and/or ASTMD 1037-91A.

B. Medium density fiberboard (MDF) shall be used in high stress areas as drawer members and shall be minimum 48 lb. density MD-21 grade and tested under ANSI A208.2 1994 Standards.

C. Industrial hardboard shall be pre-finished 1/4" thickness composed of wood fibers, phenolic resin binders and moisture inhibitors that meet or exceed the hardboard product standard ANSI/AHA A135.4 1988.

D. All countertops located with 3'-0" of any direction of built-in sink and/or bubblers shall be constructed of marine grade “Greenboard” MR moisture/water resistant particle board. The particle board shall be tested under ANSI A208.1 1-1993, M3 standards.

2.02 SURFACE MATERIAL

A. Exposed exteriors shall be permanently thermofused plastic laminate, fused to core using a minimum average pressure of 320 PSI and average 320 degree F. temperature. Thermofused plastic laminate shall meet ALA 1996 specification standards, as tested against the high pressure laminate NEMA LD 3-1995, VGS.028 specification standards. (Warranted for life against delamination).

B. Exposed doors and drawer fronts shall be permanently thermofused plastic laminate, fused to core using a minimum average pressure of 320 PSI and average 320 degree F. temperature. Thermofused plastic laminate shall meet ALA 1996 specification standards, as tested against the high pressure laminate NEMA LD 3-1995, VGS.028 specification standards, (Warranted for life against delamination).
C. Exposed interiors shall be permanently thermofused melamine laminate, fused to core using a minimum average pressure of 320 PSI and average 320 degree F. temperature. Thermofused melamine laminate shall meet ALA 1996 specification standards, as tested against the high pressure laminate NEMA LD 3-1995, VGS.028 specification standards. (Warranted for life against delamination).

D. Semi-exposed and concealed surfaces shall be permanently thermofused melamine laminate or high pressure decorative plastic laminate cabinet liner, 0.020" thickness for balanced construction. Thermofused melamine laminate shall meet the ALA 1996 specifications standard, as tested against the high pressure laminate NEMA LD 3-1995, VGS.028 specification standards.

2.03 EDGINGS

A. Exposed exterior cabinet front edges shall be banded with a contrasting or matching rigid PVC extrusion, 0.020" thickness, resistant to chip, crack and high impact. Edging shall have a satin finish with a UV cured top coat for additional durability. The 0.020" thick edging shall be applied with waterproof hot melt adhesive.

B. Door and drawer front edges shall be banded with a contrasting or matching rigid PVC extrusion, 3mm (1/8") thickness, resistant to chip, crack, and high impact. Edging shall have a satin finish with UV cured top coat for additional durability. The 3mm thick edging shall be applied with waterproof hot melt adhesive, and shaped to provide radiused edges and radiused corners.

C. Adjustable shelves shall be banded with PVC extrusion, resistant to chip, crack, and high impact. Edging shall have a satin finish with a UV cured top coat for additional durability. Edging shall be applied with waterproof hot melt adhesive. Shelves to be 1" thick. 0.020" thick PVC edging shall be applied to four (4) edges of adjustable shelf.

D. All other interior components, including drawers, shall be banded with a PVC extrusion, 0.020" in thickness, resistant to chip, crack, and high impact. Edging shall have a satin finish with a UV cured top coat for additional durability. Edging to be machine applied with waterproof hot melt adhesive.
2.04 COLOR SELECTIONS

A. Exposed cabinet exteriors shall be chosen from Thermofused plastic laminate selections as depicted in manufacturer's color selector guide. A minimum of seventy (70) colors and patterns shall be available as standard selection.

B. Exposed doors and drawer fronts shall be chosen from Thermofused plastic laminate selections as depicted in manufacturer's color selector guide. A minimum of seventy (70) colors and patterns shall be available as standard selection.

C. Semi-exposed surfaces, including drawer box components, shall be finished in either pearl or grey as selected from casework manufacturer's standard interior color selections.

D. Exposed interior components, including both faces of shelves and interior face of backs to match exposed cabinet exterior color selection.

E. Door and drawer front edges shall be chosen from one of twenty-two (22) trim group colors in 3mm thick PVC in contrasting or matching colors as depicted in manufacturer's color guide.

F. Exposed front edge of cabinet, including exposed interior edges, shall be selected from one of seventy (70) trim group colors in 0.020" thick PVC in contrasting or matching colors as depicted in manufacturer's color guide, or commercial match to selected exposed exterior color based on availability.

G. Semi-exposed edges of cabinet components including drawers, shall be either pearl or grey in 0.020" thick PVC.

H. Pulls shall be available in chrome, brass, bent wire and injection molded pulls in either bent wire or contour design, to be available in twenty (20) colors as selected from manufacturer's color selector.

I. Casework of substitute brands with lesser amounts or more restrictive selection requirements will not be considered equal and shall be rejected.
J. Finishes to be laminate manufacturer's matte, suede, or equivalent finish as approved by Architect. Samples will be reviewed by Architect for color, texture, and pattern only.

2.05 HARDWARE

A. Hinges

1. Concealed hinge shall be commercial grade 120 degree pivot overlay style. Hinges shall be two (2) piece construction with door hinge and cabinet mounting plate. Hinges shall be compact design with "minimal intrusive" mechanism into compartment space. Hinges shall have spring loaded self-close feature. Concealed hinges shall have 3-way (vertical, in-out, horizontal) alignment adjustments. Hinges shall be mounted with 5mm thread fasteners and nylon screw mount inserts.

   a. Two hinges used on all doors less than 47" in height, three hinges used on all doors 47" to 63" in height and four greater than 63" in height. Hinge to accommodate 13/16" (21 mm) door.

B. Door catches shall be a heavy-duty spring loaded, large diameter (17.5mm - 11/16") roller type catch mounted at bottom edge. All doors over 48" in height shall be provided with roller catch at both top and bottom of door.

C. Catch strike plate shall be injection molded ABS, with an integrally molded engagement ridge. Strike plate shall also provide a wide face bumper insuring a positive door stop.

D. Pulls shall be impact resistant injection molded bent wire, 4" length available per color selection in Article 2.04.H.

E. Drawer and slide out shelves shall be suspended with bottom mount, side and bottom attached nylon roller epoxy coated steel slides to ensure quiet, smooth operation. Lateral stability is achieved thru a special formed captive profile. Slides shall have 100 lb. load rating, with both in and out drawer stop, 3" self close feature and a side adjustment cam allowing 3mm side to side alignment.
F. Drawers specifically noted for full extension file use shall be suspended with bottom mount, side and bottom attached nylon roller epoxy coated steel slides to ensure quiet, smooth operation. Lateral stability is achieved thru a special formed captive profile. Slides shall have 150 lb. load rating, with both in and out drawer stop, and 3" self close feature. File drawer shall include extruded top mounted molded side rails to accept standard hanging file folders.

G. Knee-space, pencil drawers, and keyboard trays, shall be designed to permit under counter or support frame mounting, with 100 lb. nylon roller epoxy coated steel slides.

H. Shelf support clips for 1" thick adjustable shelves shall be injection molded clear polycarbonate. Support clips shall incorporate integral molded lock tabs to retain shelf from topping or inadvertently being lifted out. Support clip shall have 5mm dia. double pin engagement into precision bored hole pattern in cabinet vertical members. Clips shall have a molded ridge which provide pressure against edge of shelving to maintain positive pin engagement. Clip shall be designed in such a manner to provide means for permanent retention to shelf. Static test load must exceed 200lb. per clip.

I. Dividers that are 1/4" thick shall be fully adjustable and retained with injection molded clear polycarbonate clip.

J. Locks shall be cylinder type, diecast, with five (5) disc tumbler mechanism. Each lock shall be provided with milled brass key. Master key cabinets to room doors. Cabinets with multiple locks installed shall be keyed alike by room, with each cabinet in that room keyed the same unless otherwise specified. Locks shall be Remov-A-Core to give flexibility for different pass key options. Locks shall be provided on all cabinets capable of locking.

2.06 COMPONENTS

A. Base and wall cabinet ends shall be 3/4" thick particle board, laminated for balanced construction, surfaced as described in Article 2.02.A and edged as described in Article 2.03.A.

B. Base cabinet tops and bottoms shall be 3/4" thick particle board, laminated for balanced construction, surfaced as described in Article 2.02.C, and edged as described in
Article 2.03.A.

C. Wall cabinet top and bottom shall be 1" thick particle board, laminated for balanced construction, surfaced as described in Article 2.02.C, and edged as described in Article 2.03.A.

D. Vertical cabinet members shall be 3/4" thick particle board, laminated for balanced construction, surfaced as described in Article 2.02.C, and edged as described in Article 2.03D.

E. Cabinet backs shall be 1/4" thick pre-finished industrial hardboard.

F. Frame rails shall be 3/4" thick x 3 3/4" wide particle board, laminated for balanced construction, surfaced as described in Article 2.02.C, and edged as described in Article 2.03.A.

G. Sub base shall consist of two (2) toe kick support rails shall be 3/4" thick x 3 3/4" high particle board and be inset from cabinet front and back edge, to give additional load support.

H. Mounting rails shall be 3/4" thick x 3 3/4" wide particle board. Wall cabinets shall have rails positioned at the top and bottom. Base cabinet shall have rails positioned at the top of unit.

I. Drawers shall be full box design with a separate front. Drawer sides and ends shall be constructed of 5/8" medium density fiberboard with pearl or grey color thermofused melamine laminate and matching PVC top edges. Bottoms shall be 1/4" thick medium density fiberboard, pearl or grey color thermofused melamine laminate.

J. Adjustable shelves shall be 1" thick. Edges of shelf shall be banded as described in Article 2.03.C with a high impact, rigid PVC extrusion, pearl or grey in color.

K. Solid hinged doors, and drawer fronts shall be 3/4" thick material of balanced construction, surfaced as described in Section 2.02.B, edged as described in Article 2.03.B.

2.07 CONSTRUCTION

A. Cabinet parts shall be accurately machined and precision bored for premium grade quality joinery construction, utilizing automatic machinery to ensure consistent sizing.
on modular cabinets. Cabinets shall be assembled under controlled case clamp conditions, assuring final cabinet squareness and proper joint compressions.

B. Cabinet ends shall be bored to receive 8mm, industrial grade hardwood laterally fluted dowels with chamfered ends. Cabinet ends shall be prepared to receive adjustable shelf hardware at 32mm (approximately 1 1/4") centers. Door hinges and drawer slides shall be machined drilled to maintain vertical and horizontal alignment of components. Inset grooving with chamfer shall be machined 3/4" from rear edge to accept the 1/4" back. Base units shall have one piece end panels continuous to floor for added load capabilities.

C. Tops and bottoms shall be joined to cabinet ends using a minimum of six (6) dowels at each joint for twenty-four (24) inch deep cabinets and a minimum of four (4) dowels at each joint, for twelve (12) inch deep cabinets. All dowels to be industrial grade hardwood, laterally fluted, with chamfered ends and 8mm in diameter. Top of base cabinet will be full depth. Inset grooving with chamfer shall be machined 3/4" from rear edge to accept the 1/4" back.

D. Vertical dividers shall be bored to receive adjustable shelf hardware at 32 mm (approximately 1 1/4") centers. Dividers shall be joined to tops and bottoms with 8mm diameter hardwood dowels.

E. Frame rails shall be joined to ends with 8mm diameter hardwood dowels.

F. Two (2) toe kick supports shall be inset from cabinet front and back edges, and doweled into cabinet ends with 8mm hardwood dowels.

G. Mounting rails shall be fully concealed behind backs. Rails shall be 3/4" thick and fastened to cabinet ends with 8mm hardwood dowels. Wall cabinets shall incorporate two mounting rails. Wall cabinets shall have rails positioned at top and bottom. Base units shall have rail positioned in the upper back area.

H. Back panels shall be 1/4" thick and inset 3/4" from rear edge of cabinet. Back shall be glued and continuously trapped in top, bottom and ends of cabinets.
I. Drawer corner joints shall be interlocking dowel pin design. Hardwood dowel pins, 8mm diameter shall be inserted into drawer fronts and backs to fit into machined hole patterns in drawer sides. Bottoms shall be trapped into grooves on all four sides glued and mechanical fastened. Drawers shall be suspended on slides as described in Article 2.05.E.

2.08 WORK SURFACES

A. Core material having particle board shall be of a minimum 45 lb. density, M-2 industrial grade. The particle board used shall have been tested under ANSI A208.1 1993 standards and/or ASTMD 1037-91A.

B. Surface material shall be high pressure decorative plastic laminate thermoset to core using catalyzed PVA glue with a minimum average pressure of 90 PSI and average 180 degree F temperature. High pressure decorative plastic laminate shall meet NEMA LD 3-1995, HGP.039 specification standards.

C. Color selection shall be high pressure decorative plastic laminate selections as depicted in manufacturer's color selector guide. A minimum of seventy (70) colors and patterns shall be available as standard selection.

D. Exposed edges shall be high 180 degree roll-edge unless noted otherwise on drawings.

E. Underside of all work surfaces to have BK-20 backer or approved equivalent. This balance sheet shall be thermoset to core using catalyzed PVA glue with a minimum average pressure of 90 PSI and average 180 degree F temperature.

F. Counter Tops

1. Deck shall consist of two layers of 3/4" (19 mm) particle board at the front edge and all other exposed edges providing a total thickness of 1 1/2" (40 mm). Solid patterns or wood grain colors of FORMICA or WILSONART brand high-pressure plastic laminate may be selected for the surfaces. The method of application of the laminate to the substrate shall be as recommended by the Decorative Plastic Laminate Association.
2. Attached back splashes will have 1/4" (6 mm) of scribe on them to allow for normal field variances. Loose back splashes will not have scribe.

G. Physical Properties shall meet minimally:

1. Flexural Strength  ASTM-Method D-790  16,000/psi
2. Compressive Strength  ASTM-Method D-695  36,500/psi
3. Hardness Rockwell M  ASTM-Method D-785  110
4. Density Gr./CC.  ASTM-Method D-792  123.55 lbs/ft³
5. Water Absorption  ASTM-Method D-570  0.0076%

2.09 COLOR SELECTION

A. Laminate Color Selection:

1. Select from the full range of Wilsonart® stock color charts for cabinet faces, exposed ends, open interiors and countertops.

B. Hinge and Pull Color Selection:

1. Select from full range of stock and custom colors.

C. Miscellaneous Hardware Color Selection (support brackets, table frames, rail):

1. Select from full range of stock and custom colors.

D. 3mm PVC Edge Banding Color Selection:

1. Select from full range of stock and custom colors.

PART 3 - EXECUTION

3.01 INSTALLATION

A. The Installer must examine the job site and the conditions under which the work in this section is to be performed, and notify the General Contractor in writing of any unsatisfactory conditions. Do not proceed with work under this section until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

B. Casework, countertops, and related materials to be conditioned to average prevailing humidity condition in
C. Install casework and countertops with factory-trained supervision authorized by manufacturer. Casework shall be installed plumb, level, true and straight with no distortions. (Shim as required). Securely attached to building structure with anchorage devices of appropriate type, size and quantity to meet applicable codes, specifications and safety conditions. Where laminate clad casework and countertops abuts other finished work, scribe and trim to accurate fit.

D. Adjust casework and hardware so that doors and drawers operate smoothly without warp or bind. Lubricate operating hardware as recommended by the manufacturer.

E. Repair, or remove and replace, defective work as directed upon completion of installation.

F. Clean plastic surfaces, repair minor damage per plastic laminate manufacturer's recommendations. Replace other damaged parts of units.

G. Advise Owner's Representative of procedures and precautions for protection of casework and countertops from damage by other trades until acceptance of work by Owner.

H. Cover casework with 4-mil polyethylene film for protection against soiling and deterioration during remainder of construction period.
PART 1 - GENERAL

1.01 RELATED DOCUMENTS:
A. Attention is directed to Division 0, Bidding and Contract Requirements, and to Division 1, General Requirements, which are hereby made a part of this Section.

1.02 DESCRIPTION OF WORK:
A. The extent of window treatments is shown on the drawings.

1.03 SECTION INCLUDES:
A. Window shades both manual and motorized with associated accessories for glare and sunlight control.

1.04 QUALITY ASSURANCE:
A. Manufacturer: Provide window treatments manufactured by one of the following:
   1. Draper.(Basis of Design)

1.05 PRODUCTS SUPPLIED:
A. Furnish and install manual and motorized roll up fabric interior FlexShade System manufactured by Draper, Inc., 411 South Pearl Street, P.O. Box 425, Spiceland, IN 47385-0425. Phone number: (800)238-7999. Contact: Art Tober (586) 416-0829, atober@draperinc.com

1.06 SUBMITTALS:
A. Manufacturer’s Product Data: Submit manufacturer’s descriptive product data and installation instructions for each type of window treatment specified.
B. Shop Drawings: Submit, indicating the following:
   1. Room schedule with field-verified dimensions of openings scheduled to receive manual FlexShades with brackets, fascia and endcaps, outside mount just beyond window mullion (unless indicated otherwise).
   2. Indicate fabric selection, operator, hardware style, and all associated material required for a complete installation.
3. Typical wiring diagrams including integration of motor controllers with building management system, audio visual and lighting control systems as applicable.

1.07 PRODUCT DELIVERY

A. Deliver to job site in manufacturer’s original cartons.

B. Manual FlexShades to be labeled according to room schedule.

C. Manual FlexShades to be carefully handled and stored to prevent damage to materials, finishes, and operating mechanisms.

D. Installer responsible for acceptable installation.

PART 2 – PRODUCT

2.01 MANUFACTURED UNITS – MANUAL SHADES

A. Provide SheerWeave Series SW2703 fabric by Phifer-FlexShades as manufactured by Draper Systems Inc., Spiceland, IN. Color to be selected by Owner from manufacturer’s standard colors. Exterior color shall be white.

   1. Shade fabric shall be as follows: A glare control shade fabric shall be 36% fiberglass, 64% vinyl on fiberglass, woven into a duplex basketweave pattern; washable and flame-retardant.

      a. Fire Rating:
         1. NFPA – 701-1999 TM #1 (small scale)
         2. NFPA – 101 (Class A rating)

     b. Fabric shall be min. 14.00 oz/s.y., .028” thick.

     c. Fabric shall be avg. 3% open.

     d. Roll width – widths as shown on the drawings.

     e. Meet requirements of ASTM G-21 fungal growth testing and ASTM-G22.

   2. Provide manual FlexShade System using bead chain clutch operator with chain hold down device (mounted on RH side of shade, unless noted otherwise) and brackets, fascia and endcaps. Provide all mounting hardware for a complete system.
2.02 MOTORIZED WINDOW SHADES

A. Type: Motorized vertical roll-up, fabric, window shade with motors, controls, mounting brackets, and other components necessary for complete installation; Motorized FlexShade as manufactured by Draper, Inc.
   1. Ceiling pocket created by others. 6”x6” square
   2. Wall Clip with Closure panel: For site constructed ceiling recesses, provide removable closure panel to minimize slot for shade passage but allowing access to shade for maintenance.
      a. Material: Aluminum alloy with white epoxy paint finish.
      b. Closure width: 3 inches (75 mm).

B. Shade Motor and Control System
   1. Standard Motor: 110 VAC, single phase, 60 Hz, instantly reversible, lifetime lubricated, and equipped with internal thermal overload protector, electric brake, and pre-set accessible limit switches. Tubular motor concealed inside each shade roller tube.
      a. Group Control:

C. Roller: Fabricated from extruded aluminum or steel. Diameter, wall thickness, and material selected by manufacturer to accommodate shade size. Provide with roller idler assembly of molded nylon and zinc-plated steel pin. Sliding pin to allow easy installation and removal of roller. Fabric connected to the roller tube with LiSE (low surface energy) double sided adhesive specifically developed to attach coated textiles to metal. Adhesive attachment to eliminate horizontal impressions in fabric.

D. Shade slat: Slat encased in heat-seamed hem.

E. FABRIC-Light-Filtering Fabrics
F. Color and pattern: As indicated in Color Schedule on Drawings.

G. Color and pattern: As selected by Architect from manufacturer's standard range.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installer must examine the substrates and conditions under which the window treatments are to be installed, and notify the General Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Installer.

3.02 PREPARATION

A. Coordinate requirements for blocking, construction of shade pockets, and structural supports to ensure adequate means for installation of window shades.

Coordinate requirements for power supply conduit, and wiring required for window shade motors and controls.

3.03 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install roller shades level, plumb, square, and true. Allow proper clearances for window operation hardware.

C. Install the following items to conceal roller and operating mechanism. Do not use exposed fasteners.
   1. Closure panels.

3.04 TESTING AND DEMONSTRATION

A. Test motorized window shades to verify that controls, limit switches, interface to other building systems, and other operating components are functional. Correct deficiencies.

B. Test window shades to verify that operating mechanism, fabric retainer, and other operating components are functional. Correct deficiencies.
   1. Motorized operating mechanism.

C. Demonstrate operation of shades to Owner's designated representatives.
3.05 PROTECTION
   A. Protect installed products until completion of project.
   B. Touch-up, repair or replace damaged products before Substantial Completion.

3.06 SCHEDULES
   A. Refer to Drawings for shade types and locations.

END OF SECTION 12492
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions.

1.2 REFERENCES

A. Underwriters Laboratories:

B. National Institute of Justice Ballistic Standards:
1. NIJ Standard 0108.01 - Type III-A

C. American Society for Testing and Materials:
1. ASTM E119-98 Standard Test for One-Hour Fire-Rating of Building Construction and Materials

1.3 SUBMITTALS

The following shall be submitted in accordance with Section 13471 and Division 1 Requirements (Submit for approval prior to fabrication samples, brochures, specifications):

A. UL LISTING Verification and UL752 Current Test Results as provided by Underwriters Laboratories.
B. Printed data in sufficient detail to indicate compliance with the contract documents.
E. Manufacturer’s Instructions for installation of Bullet Resistant Fiberglass Panels.
1.4 DESIGN

A. Through the design, manufacturing technique and material application the Bullet Resistant Fiberglass shall be of the “non ricochet type.” This design is intended to permit the encapture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration.

1.7 DELIVERY, HANDLING, AND STORAGE

A. Deliver the materials to the project with the manufacturer’s UL LISTED Labels intact and legible.

B. Handle the material with care to prevent damage. Store the materials inside under cover, stack flat and off the floor.

1.8 WARRANTY

A. All materials and workmanship shall be warranted against defects for a period of two (2) years from the date of receipt at the project site.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturers:
   1. Waco Composites, Ltd., Waco, TX 76710, fax: 254-752-3634, 254-752-3622
      email: sales@armorcore.com
   2. Shotshield as manufactured by Protective Structures Ltd., 7565 Industrial Court, Alpharetta, GA 30004, 888-521-8666. www.shotshield.com

2.2 MATERIAL

A. The panels shall be made of multiple layers of woven roving ballistic grade fiberglass cloth impregnated with a thermoset polyester resin and compressed into flat rigid sheets. The production technique and materials used shall provide the controlled internal delamination to defeat the penetrating projectile.

B. Bullet Resistant Fiberglass panels: 7/16” nominal thickness, and 4.8 lbs. per sq. ft. nominal weight.
2.3 SECURITY LEVEL

A. The Bullet Resistant Fiberglass will be warranted to meet the requirements of UL752 Level 3.

PART 3 - EXECUTION

3.1 SUPPORTING MEMBERS

A. Prior to installing the bullet resistive material the contractor shall verify that all supports have been installed as required by the contract documents and the architectural drawings.

3.2 JOINTS

A. All joints shall be reinforced by a back-up layer of bullet resistive material. The bullet resistance of the joint, as reinforced, shall be at least equal to that of the panel. Minimum width of reinforcing layer at joint shall be 4-inches (2” on each panel or a 2” minimum overlap).

3.3 APPLICATION

A. Armor shall be installed in accordance with the manufacturer’s printed recommendations. Armor panels shall be adhered using an industrial adhesive, mastic, screws or bolts. Method of application shall maintain the bullet resistive rating at junctures with the concrete floor slab, the concrete roof slab, the bullet resistive door frames, the bullet resistive window frames, and all required penetrations.

END OF SECTION 13471
SECTION 13915 - FIRE-SUPPRESSION SYSTEM

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PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

B. Provisions of Division 15 Section “Mechanical General Requirements” apply to this Section.

C. Related Sections include the following:

1. Division 02 Section "Water Distribution" for piping outside the building.
2. Division 10 Section "Fire-Protection Specialties" for cabinets and fire extinguishers.
3. Division 15 Section “Basic Mechanical Materials and Methods.”
4. Division 15 Section "Hangers and Supports."
5. Division 16 Section "Fire Alarm" for alarm devices not specified in this Section.

1.2 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. High-Pressure Piping System: Fire-suppression piping system designed to operate at working pressure higher than standard 175 psig.

C. PE: Polyethylene plastic.

D. Underground Service-Entrance Piping: Underground service piping below the building.

E. Hose Connection: Valve with threaded outlet matching fire hose coupling thread for attaching fire hose.

F. Hose Station: Hose connection, fire hose rack, and fire hose.
G. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from authorities having jurisdiction.

1.3 SYSTEM DESCRIPTIONS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

1.4 PERFORMANCE REQUIREMENTS


B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. The fire protection contractor shall engage the services of an independent third party consultant to review the sprinkler layout, design hazard, flow densities, and overall compliance to code prior to issuing shop drawings to authorities having jurisdiction.

D. Fire-suppression sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 20 percent, including losses through water-service piping, valves, and backflow preventers.

2. Sprinkler Occupancy Hazard Classifications, for bidding purposes, as follows:

   a. Building Service Areas: Ordinary Hazard, Group 1.
   b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
   c. General Storage Areas: Ordinary Hazard, Group 1.
   d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
   e. Office and Public Areas: Light Hazard.
3. Minimum Density for Automatic-Sprinkler Piping Design:
   a. Light-Hazard Occupancy: 0.10 gpm/sq. ft. over 1500-sq. ft. area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
   c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm/sq. ft. over 1500-sq. ft. area.

4. Maximum Protection Area per Sprinkler:
   a. Office Spaces: 120 sq. ft.
   b. Storage Areas: 130 sq. ft.
   c. Mechanical Equipment Rooms: 130 sq. ft.
   d. Electrical Equipment Rooms: 130 sq. ft.
   e. Other Areas: According to NFPA 13 recommendations, unless otherwise indicated.

E. Water velocity in the piping system shall not exceed the following:
   1. Underground mains: 16 ft./sec.
   3. Sprinkler branch lines: 24 ft./sec.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Coordination Drawings: Sprinkler systems, drawn to scale, on which the following items are shown and coordinated
with each other, using input from installers of the items involved:

1. Domestic water piping.
2. HVAC hydronic piping.
3. Items penetrating finished ceiling include the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.

E. Qualification Data: For qualified Installer.

F. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, the Owner’s insurance underwriter including hydraulic calculations, if applicable.

1. Sprinklers shall be referred to on drawings, submittals, and other documentation, by the sprinkler identification number (SIN) or model number as specifically published in the appropriate agency listing or approval. Trade names or other abbreviated designations shall not be allowed.

G. Welding certificates.

H. Fire-hydrant flow test report.

I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

J. Field quality-control reports.

K. Operation and Maintenance Data: For sprinkler specialties to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installer's responsibilities include designing, fabricating, and installing fire-suppression systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.

   a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

B. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

C. The provisions and requirements of the NFPA and the Owner's insurance underwriter constitute mandatory minimum requirements for the work of this Section.

D. NFPA Standards: Fire-suppression-system equipment, specialties, accessories, installation, and testing shall comply with the following:

   1. NFPA 13, "Installation of Sprinkler Systems."
   2. NFPA 24, "Installation of Private Fire Service Mains and Their Appurtenances."

1.7 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

B. Coordinate with ceiling installer to ensure proper grid type and installation for use with flexible sprinkler drops.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Sprinkler Cabinets: Finished, wall-mounting, steel cabinet with hinged cover, with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler
wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler on Project.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DUCTILE-IRON PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe: AWWA C151, pressure class 350, with mechanical-joint bell end and plain end.

1. Mechanical-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron gland, rubber gasket, and steel bolts and nuts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, pressure class 350, with push-on-joint bell end and plain end.

1. Push-on-Joint, Ductile-Iron Fittings: AWWA C110, ductile- or gray-iron standard pattern or AWWA C153, ductile-iron compact pattern.

2. Gaskets: AWWA C111, rubber.

C. Encasement for Underground Ductile-Iron Piping: ASTM A 674 or AWWA C105, PE film, 0.008-inch minimum thickness, tube or sheet.

2.3 STANDARD-WEIGHT BLACK STEEL PIPE AND FITTINGS

A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed threaded ends, and with factory applied antimicrobial coating on inner wall of pipe.

5. Steel Threaded Couplings: ASTM A 865.

B. Plain-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, and with factory applied antimicrobial coating on inner wall of pipe.
   2. Steel Flanges and Flanged Fittings: ASME B16.5.

C. Grooved-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, with factory- or field-formed, square-cut- or roll- grooved ends, and with factory applied antimicrobial coating on inner wall of pipe.
   1. Grooved-Joint Piping Systems:
      a. Manufacturers:
         1) Anvil International, Inc.; Model 7401.
         2) Tyco Fire & Building Products; Grinnell Mechanical Products; Model 577 or 772.
         3) Victaulic Co. of America; Style 005 or 009.
         b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
         c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

2.4 STANDARD-WEIGHT GALVANIZED STEEL PIPE AND FITTINGS

A. Threaded-End, Standard-Weight Steel Pipe: ASTM A 53/A 53M, ASTM A 135, or ASTM A 795, hot-dip galvanized, with factory- or field-formed threaded ends.

1. Grooved-Joint Piping Systems:
   a. Manufacturers:
      1) Anvil International, Inc.; Model 7401.
      2) Tyco Fire & Building Products; Grinnell Mechanical Products; Model 577 or 772.
      3) Victaulic Co. of America; Style 005 or 009.
   b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
   c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

2.5 SCHEDULE 10 BLACK STEEL PIPE AND FITTINGS

A. Plain-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13 specified wall thickness in NPS 6 to NPS 10, and with factory applied antimicrobial coating on inner wall of pipe.
2. Steel Flanges and Flanged Fittings: ASME B16.5.
B. Grooved-End, Schedule 10 Steel Pipe: ASTM A 135 or ASTM A 795, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10; with factory- or field-formed, roll-grooved ends, and with factory applied antimicrobial coating on inner wall of pipe.

1. Grooved-Joint Piping Systems:
   a. Manufacturers:
      1) Anvil International, Inc.; Model 7401.
      2) Tyco Fire & Building Products; Grinnell Mechanical Products; Model 577 or 772.
      3) Victaulic Co. of America; Style 005 or 009.
   b. Grooved-End Fittings: UL-listed, ASTM A 536, ductile-iron casting with OD matching steel-pipe OD.
   c. Grooved-End-Pipe Couplings: UL 213 and AWWA C606, rigid pattern, unless otherwise indicated; gasketed fitting matching steel-pipe OD. Include ductile-iron housing with keys matching steel-pipe and fitting grooves, rubber gasket listed for use with housing, and steel bolts and nuts.

2.6 BACKFLOW PREVENTION DEVICES

A. Double-Check, Detector-Assembly Backflow Preventers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.
      b. FEBCO; a Division of Watts Water Technologies, Inc.
      c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
      d. Watts Water Technologies, Inc.; Watts Regulator Co.
      e. Zurn Plumbing Products Group; Wilkins Div.
   2. Standard: ASSE 1048 and FMG approved or UL listed.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
   5. Size and Capacities: As scheduled on the drawings.
6. Body: Cast-iron or ductile-iron, with interior lining complying with AWWA C550 or that is FDA approved.


8. Configuration: Designed for horizontal, straight through flow.

9. Accessories:

   a. Valves: Outside screw and yoke gate-type with flanged ends on inlet and outlet.
   b. Bypass: With displacement-type water meter, shutoff valves, and double-check backflow prevention device.

2.7 SPRINKLER SPECIALTY FITTINGS

A. Sprinkler specialty fittings shall be UL listed or FMG approved, with 175-psig minimum working-pressure rating, and made of materials compatible with piping. Sprinkler specialty fittings shall have 300-psig working-pressure rating if fittings are components of high-pressure piping system.

B. Sprinkler Drain and Alarm Test Fittings: Cast- or ductile-iron body; with threaded or locking-lug inlet and outlet, test valve, and orifice and sight glass.

1. Manufacturers:

   a. Tyco Fire & Building Products LP.
   b. Fire-End and Croker Corp.
   c. Viking Corp.
   d. Victaulic Co. of America.

C. Sprinkler Branch-Line Test Fittings: Brass body with threaded inlet, capped drain outlet, and threaded outlet for sprinkler.

1. Manufacturers:


D. Sprinkler Inspector's Test Fitting: Cast- or ductile-iron housing with threaded inlet and drain outlet and sight glass.

1. Manufacturers:
a. AGF Manufacturing Co.
b. Tyco Fire & Building Products LP.
c. G/J Innovations, Inc.
d. Triple R Specialty of Ajax, Inc.

e. Drop-Nipple Fittings: UL 1474, adjustable with threaded inlet and outlet, and seals.

1. Manufacturers:

a. CECA, LLC.
b. Merit.

F. Flexible Sprinkler Drop Fittings:

1. Manufacturers:

a. Victaulic Co. of America; AquaFlex Sprinkler Fittings; AH-2 with AB1 Bracket Assembly.
b. FlexHead Industries, Inc.

2. Description: UL listed and FMG approved flexible hose for connection to sprinkler, and with bracket for connection to commercial ceiling grid.


4. Pressure Rating: 175 psig minimum; 300 psig if fittings are components of high-pressure piping system.

5. Size: Same as connected piping, for sprinkler.

2.8 LISTED FIRE-PROTECTION VALVES

A. Valves shall be UL listed or FMG approved, with 175-psig minimum pressure rating.

B. Gate Valves with Wall Indicator Posts:

1. Gate Valves: UL 262, cast-iron body, bronze mounted, with solid disc, nonrising stem, operating nut, and flanged ends.

2. Indicator Posts: UL 789, horizontal-wall type, cast-iron body, with hand wheel, extension rod, locking device, and cast-iron barrel.

3. Manufacturers:

a. McWane, Inc.; Kennedy Valve Div.
b. NIBCO.
c. Crane Co.; Crane Valve Group; Stockham Valves.

C. Ball Valves: Comply with UL 1091, except with ball instead of disc.
   1. NPS 1-1/2 and Smaller: Bronze body with threaded ends.
   2. NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
   3. NPS 3: Ductile-iron body with grooved ends.
   4. Manufacturers:
      a. NIBCO.
      b. Victaulic Co. of America.

D. Butterfly Valves: UL 1091.
   1. NPS 2-1/2 and Larger: Bronze, cast-iron, or ductile-iron body; wafer type or with flanged or grooved ends.
      a. Manufacturers:
         1) McWane, Inc.; Kennedy Valve Div.
         2) Mueller Company.
         3) NIBCO.
         4) Tyco Fire & Building Products.
         5) Victaulic Co. of America.

E. Check Valves NPS 2 and Larger: UL 312, swing type, cast-iron body with flanged or grooved ends.
   1. Manufacturers:
      a. Crane Co.; Crane Valve Group; Crane Valves.
      b. Crane Co.; Crane Valve Group; Jenkins Valves.
      c. Tyco Fire & Building Products.
      d. Hammond Valve.
      e. McWane, Inc.; Kennedy Valve Div.
      f. Mueller Company.
      g. NIBCO.
      h. Crane Co.; Crane Valve Group; Stockham Valves.
      i. Victaulic Co. of America.

F. Gate Valves: UL 262, OS&Y type.
   1. NPS 2 and Smaller: Bronze body with threaded ends.
a. Manufacturers:

1) Crane Co.; Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) NIBCO.

2. NPS 2-1/2 and Larger: Cast-iron body with flanged ends.

a. Manufacturers:

1) McWane, Inc.; Clow Valve Co.
2) Crane Co.; Crane Valve Group; Crane Valves.
3) Crane Co.; Crane Valve Group; Jenkins Valves.
4) Hammond Valve.
5) Milwaukee Valve Company.
6) Mueller Company.
7) NIBCO.

G. Indicating Valves: UL 1091, with integral indicating device and ends matching connecting piping.

1. Indicator: Electrical, 115-V ac, prewired, single-circuit, supervisory switch.
2. NPS 2 and Smaller: Ball or butterfly valve with bronze body and threaded ends.

a. Manufacturers:

1) Milwaukee Valve Company.
2) NIBCO.
3) Victaulic Co. of America.

3. NPS 2-1/2 and Larger: Butterfly valve with cast- or ductile-iron body; wafer type or with flanged or grooved ends.

a. Manufacturers:

1) Tyco Fire & Building Products LP.
2) McWane, Inc.; Kennedy Valve Div.
3) Milwaukee Valve Company.
4) NIBCO.
5) Victaulic Co. of America.
2.9 UNLISTED GENERAL-DUTY VALVES

A. Ball Valves NPS 2 and Smaller: MSS SP-110, 2-piece copper-alloy body with chrome-plated brass ball, 600-psig minimum CWP rating, blowout-proof stem, and threaded ends.

B. Check Valves NPS 2 and Smaller: MSS SP-80, Type 4, Class 125 minimum, swing type with bronze body, nonmetallic disc, and threaded ends.

C. Gate Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, solid wedge, and threaded ends.

D. Globe Valves NPS 2 and Smaller: MSS SP-80, Type 2, Class 125 minimum, with bronze body, nonmetallic disc, and threaded ends.

2.10 AUTOMATIC (BALL DRIP) DRAIN VALVES

A. General:

2. Pressure Rating: 175 psig minimum.
3. Type: Automatic draining, ball check.
5. End Connections: Threaded.

B. Manufacturer:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products.

2.11 SPRINKLERS

A. Sprinklers shall be UL listed or FMG approved, with 175-psig minimum pressure rating. Sprinklers shall have 300-psig pressure rating if sprinklers are components of high-pressure piping system.

B. Manufacturers:

1. Reliable Automatic Sprinkler Co., Inc.
2. Tyco Fire & Building Products.
3. Victaulic Co. of America.
4. Viking Corp.
C. Automatic Sprinklers:

1. With heat-responsive glass bulb element complying with the following:
   a. UL 199, for nonresidential applications.
   b. UL 1767, for early-suppression, fast-response applications.

   a. Orifice: 1/2 inch, with discharge coefficient $K$ between 5.3 and 5.8.
   b. Orifice: 17/32 inch, with discharge coefficient $K$ between 7.4 and 8.2.

D. Sprinkler Types and Categories: Nominal 1/2-inch orifice for 165 deg F "Ordinary" temperature classification rating, unless otherwise indicated or required by application.

E. Sprinkler types, features, and options as follows:

1. Concealed ceiling sprinklers, including cover plate.
2. Extended-coverage sprinklers.
3. Flush ceiling sprinklers, including escutcheon.
4. Open sprinklers.
5. Pendent sprinklers.
7. Recessed sprinklers, including escutcheon.
8. Sidewall sprinklers.
9. Sidewall, dry-type sprinklers.
10. Upright sprinklers.

F. Sprinkler Finishes: Chrome plated, bronze, and painted.

G. Special Coatings: Wax, lead, and corrosion-resistant paint.

H. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers. Escutcheons listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
2. Sidewall Mounting: Chrome-plated steel, one piece, flat.

I. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler. Sprinkler guards listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

2.12 FIRE DEPARTMENT CONNECTIONS

A. Manufacturers:
   2. Potter-Roemer; Fire-Protection Div.

B. Wall-Type, Fire Department Connection: UL 405, 175-psig minimum pressure rating; with corrosion-resistant-metal body with brass inlets, brass wall escutcheon plate, brass lugged caps with gaskets and brass chains, and brass lugged swivel connections. Include inlets with threads according to NFPA 1963 and matching local fire department sizes and threads, outlet with pipe threads, extension pipe nipples, check devices or clappers for inlets, and escutcheon plate with marking similar to "AUTO SPKR & STANDPIPE."
   1. Type: Exposed, projecting, with two inlets and round escutcheon plate.
   2. Type: Flush, with two inlets and square or rectangular escutcheon plate.

2.13 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Electrically Operated Alarm: UL 464, with 6-inch minimum-diameter, vibrating-type, metal alarm bell with red-enamel factory finish and suitable for outdoor use.
   1. Manufacturers:
      b. System Sensor.
C. Water-Flow Indicator: UL 346, electrical-supervision, paddle-operated-type, water-flow detector with 250-psig pressure rating and designed for horizontal or vertical installation. Include two single-pole, double-throw circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed.

1. Manufacturers:
   b. System Sensor.

D. Pressure Switch: 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.

1. Manufacturers:
   b. System Sensor.

E. Valve Supervisory Switch: UL 753, electrical, single-pole, double-throw switch with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

1. Manufacturers:
   b. System Sensor.

2.14 PRESSURE GAGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge.
2. Ashcroft Inc.
3. Marsh Bellofram.
4. Viking Corp.
5. Weiss Instruments, Inc.

B. Description: UL 393, 3-1/2- to 4-1/2-inch- diameter, dial pressure gage with range of 0 to 250 psig minimum.
1. Water System Piping: Include caption "WATER" on dial face.

PART 3 - EXECUTION

3.1 PREPARATION

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in Part 1 "Quality Assurance" Article.

B. Report test results promptly and in writing.

3.2 EARTHWORK

A. Refer to Division 02 Section "Earthwork" for excavating, trenching, and backfilling.

3.3 EXAMINATION

A. Examine roughing-in for hose connections and stations to verify actual locations of piping connections before installation.

B. Examine walls and partitions for suitable thicknesses, fire- and smoke-rated construction, framing for hose-station cabinets, and other conditions where hose connections and stations are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PIPING APPLICATIONS, GENERAL

A. Flanges, flanged fittings, unions, nipples, grooved-joint couplings, and transition and special fittings with finish and pressure ratings same as or higher than system's pressure rating may be used in aboveground applications, unless otherwise indicated.

B. Piping between Fire Department Connections and Check Valves: Galvanized, standard-weight steel pipe with threaded ends; cast- or malleable-iron threaded fittings; and threaded joints; or grooved ends; grooved-end fittings; grooved-end-pipe couplings; and grooved joints.
C. Underground Service-Entrance Piping: Ductile-iron, push-on or mechanical-joint pipe and fittings and restrained joints. Include corrosion-protective encasement.

3.5 SPRINKLER RISER AND STANDPIPE SYSTEM PIPING APPLICATIONS

A. Refer to drawings.

3.6 SPRINKLER SYSTEM PIPING APPLICATIONS

A. Refer to specifications on drawings.

3.7 VALVE APPLICATIONS

A. The following requirements apply:

1. Listed Fire-Protection Valves: UL listed or FMG approved for applications where required by NFPA 13.
   a. Shutoff Duty: Use ball, butterfly, or gate valves.

2. Unlisted General-Duty Valves: For applications where UL-listed and FMG-approved valves are not required by NFPA 13.
   a. Shutoff Duty: Use ball, butterfly, or gate valves.

3.8 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Threaded Joints: Comply with NFPA 13 for pipe thickness and threads. Do not thread pipe smaller than NPS 8 with wall thickness less than Schedule 40 unless approved by authorities having jurisdiction and threads are checked by a ring gage and comply with ASME B1.20.1.

C. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to "Quality Assurance" Article.

   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

D. Use of saddle style tees is not acceptable.
E. Grooved Joints: Assemble joints with listed coupling and gasket, lubricant, and bolts.

1. All grooved couplings, fittings, gaskets, valves, and specialties shall be the product of a single manufacturer.
2. Steel Pipe: Square-cut or roll-groove piping as indicated. Use grooved-end fittings and rigid, grooved-end-pipe couplings, unless otherwise indicated.

F. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Division 15 Section “Basic Mechanical Materials and Methods” for additional requirements.

3.9 SERVICE-ENTRANCE PIPING

A. Connect fire-suppression piping to water-service piping of size and in location indicated for service entrance to building. Refer to Division 02 Section "Water Distribution" for exterior piping.

B. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-service piping. Refer to Division 02 Section "Water Distribution" for backflow preventers.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water service.

3.10 WATER-SUPPLY CONNECTION

A. Connect fire-suppression piping to building's interior water distribution piping.

B. Install shutoff valve, backflow prevention device, pressure gage, drain, and other accessories indicated at connection to water distribution piping.

C. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

D. Antifreeze Sprinkler System: Install check valve with 1/32-inch hole in clapper, drain valve, fill cup or filling connection, and other accessories indicated at connection to fire-suppression piping.
3.11 PIPING INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping installation.

B. Install underground ductile-iron service-entrance piping according to NFPA 24 and with restrained joints. Encase piping in corrosion-protective encasement.

C. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

E. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, sized and located according to NFPA 13.

G. Install sprinkler piping with drains for complete system drainage.

H. Install sprinkler zone control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install drain valves on standpipes.

J. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building.

K. Install alarm devices in piping systems.

L. Hangers and Supports: Comply with NFPA 13 for hanger materials.
   1. Install standpipe system piping according to NFPA 14.
   2. Install sprinkler system piping according to NFPA 13, except use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting pipes larger than NPS 2-1/2.
3. Refer to Division 15 Section “Hangers and Supports” for additional requirements.

M. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

N. Drain dry-type standpipe piping.

O. Drain dry-pipe sprinkler piping.

P. Fill wet-standpipe system piping with water.

Q. Fill wet-pipe sprinkler system piping with water.

3.12 INSTALLATION OF COVER SYSTEM FOR SPRINKLER PIPING

A. Install cover system, brackets, and cover components for sprinkler piping according to manufacturer's "Installation Manual" and with NFPA 13 or NFPA 13R for supports.

3.13 VALVE INSTALLATION

A. Install listed fire-protection valves, unlisted general-duty valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Valves for Wall-Type Fire Hydrants: Install nonrising-stem gate valve in water-supply pipe.

D. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water supply sources.
3.14 SPRINKLER APPLICATIONS

A. Use the following sprinkler types:

1. Rooms without Ceilings: Upright sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.
3. Holding Cells and Holding Corridors: Institutional Flush Pendant sprinklers; tamper-resistant construction for correctional facilities.
5. Spaces Subject to Freezing: Pendent, dry sprinklers.
6. Sprinkler Finishes:
   a. Upright, Pendent, and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes; white polyester finish in natatoriums.
   b. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   c. Flush Sprinklers: Bright chrome, with painted white escutcheon.
   d. Recessed Sprinklers: Bright chrome, with bright chrome escutcheon.
7. Sprinkler Guards: For exposed sprinkler heads subject to damage.

3.15 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels and tiles.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers with water supply from heated space.

C. Install sprinklers into flexible sprinkler drop fittings and install into bracket on ceiling grid. Install according to manufacturer’s instructions and NFPA, State, and local guidelines. Ceiling grid must meet requirements of ASTM C 635 and C 636, coordinate with ceiling installer.
3.16 FIRE DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire department connections in vertical wall.

B. Install ball drip valve at each check valve for fire department connection.

3.17 CONNECTIONS

A. Install piping adjacent to equipment to allow service and maintenance.

B. Connect water-supply piping to fire-suppression piping. Include backflow preventer between potable-water piping and fire-suppression piping. Refer to Division 15 Section "Domestic Water Piping Specialties" for backflow preventers.

C. Install ball drip valves at each check valve for fire department connection. Drain to floor drain or outside building.

D. Connect piping to specialty valves, hose valves, specialties, fire department connections, and accessories.

E. Electrical Connections: Power wiring and fire alarm wiring are specified in Division 16.

F. Connect alarm devices to fire alarm.

G. Ground equipment according to Division 16 Section "Grounding and Bonding."

H. Connect wiring according to Division 16 Section "Conductors and Cables."

I. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.18 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and in Division 15 Section "Mechanical Identification."
B. Label antifreeze sprinkler system according to requirements in NFPA 13. Labels and equipment signs are specified in Division 15 Section "Mechanical Identification."

1. Include identification at riser that supplies antifreeze system.
2. Include signage indicating manufacturer type and brand of antifreeze solution, concentration of antifreeze solution, and volume of antifreeze in the system.

3.19 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Flush, test, and inspect standpipe systems according to NFPA 14, "System Acceptance" Chapter.
5. Verify that equipment hose threads are same as local fire department equipment.
6. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.

B. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

C. Verify that excess-pressure pumps and accessories are installed and operate correctly.

D. Verify that air compressors and their accessories are installed and operate correctly.

E. Verify that specified tests of piping are complete.

F. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.
G. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.

H. Verify that potable-water supplies have correct types of backflow preventers.

I. Energize circuits to electrical equipment and devices.

J. Adjust operating controls and pressure settings.

K. Coordinate with fire alarm tests. Operate as required.

L. Report test results promptly and in writing to Architect and authorities having jurisdiction.

3.20 CLEANING AND PROTECTION

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

C. Protect sprinklers from damage until Substantial Completion.

3.21 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

END OF SECTION 13915
SECTION 14100 - DUMBWAITERS

Part 1 - General

1.01 Section Includes

This section includes all labor and materials necessary for the furnishing and installing of an electrically operated dumbwaiter as indicated on the drawing and/or specified herein.

1.02 Related Sections

A. A suitable, legal two-hour fire rated hoistway shall be provided on a concrete slab. The hoistway shall be plumb and hold its clear dimensions with no obstructions such as pipes or ductwork. Note: Hoistway door walls shall NOT be erected until Dumbwaiter doors are set in place.

1. Section 03001 – Concrete Work
2. Section 04300 – Unit Masonry Work
3. Section 06100 – Carpentry
4. Section 09250 – Gypsum Drywall

B. All bracket fastening inserts and other steel required for support of guide rails and brackets.
1. Section 05500 – Metal Fabrications

C. Painting of exterior walls and prime finished components that are exposed to view, including inside of car, car gates and doors.
1. Section 09970 – High Performance Coatings

D. A power line from the source to an approved 30 ampere fused disconnect switch located immediately adjoining the controller cabinet must be provided. A 110V single phase machine area lighting and convenience outlet must also be provided.

1. Division 16 – Electrical
1.03 References

A. Comply with applicable building codes and elevator codes at the project site, including but not limited to the following;

3. ASME A17.5/CSA B44 - Elevator and Escalator Electrical Equipment.
5. ASME/UL - 10B Fire Tests of Door Assemblies
6. ASME/UL - 508 Industrial Controllers
7. 2015 Michigan Building Code

1.04 Submittals

A. The shop drawings will indicate physical and nominal dimensions, capacities, sizes, speeds, performances, operations, safety features, controls and finishes of equipment and accessories.

B. The shop drawings will indicate dimensions, attachments, reinforcing and location of hoistway and other fixed building components and amount of loads and reactions on building structure and will identify coordination required by other sections.

1.05 Quality Assurance

A. Manufacturer has been engineering and producing Dumbwaiter and Dumbwaiter related products for a minimum of twenty five years.

B. Manufacturers unit will be subject to city and state approval before installation and city and state inspection after installation.

C. Installer Qualifications: Company specializing in performing Work of this section and approved by dumbwaiter manufacturer.
1.06 Delivery, Storage, and Handling

A. The Dumbwaiter and its components will be contained in wooden crates or cardboard boxes made of sufficient strength to ensure the safety of its contents during reasonable transportation and storage conditions.

B. The Dumbwaiter and its components under no time during transportation or storage should be subjected to harsh weather conditions such as rain or snow.

1.08 Project/Site Conditions

A. The area and conditions in which the Dumbwaiter is to be installed will be checked by the installer and will meet their satisfaction. Installation will not proceed until the conditions and area the Dumbwaiter will be installed meet the satisfaction of the installer.

1.09 Sequencing/Scheduling

A. Prior to installation of the dumbwaiter the hoistway must be complete except no hoistway walls should be erected where Dumbwaiter entrances occur until after Dumbwaiter doors are set in place.

B. Prior to installation of the dumbwaiter a power line from the source to an approved 30 ampere fused disconnect switch must be provided. The disconnect must be located immediately adjoining the intended location of the controller cabinet. A 110V single phase machine area lighting and convenience outlet must also be provided.

1.10 Warranty

A. Manufacturer agrees to repair or replace components of the dumbwaiter that fail in materials or workmanship for a period of one year after delivery, other than that caused by normal wear and tear or misuse.

1.11 Maintenance Service
A. Furnish service and maintenance for dumbwaiter system and components for one year from the Date of Substantial Completion.

B. Include systematic examination, adjustment, and lubrication of dumbwaiter equipment. Repair or replace parts whenever required. Use parts produced by manufacturer of original equipment. Replace wire ropes when necessary to maintain required factor of safety.

C. Provide emergency call back service for this maintenance period.

D. Perform maintenance work using competent and qualified personnel approved by dumbwaiter manufacturer or original

PART 2- PRODUCTS

2.01 MANUFACTURES

A. Manufactures: Subject to compliance with requirements, provide products by the following:

1. Matot Inc, 2501 Van Buren, Bellwood, Illinois 60104
   Phone: 800-369-1070    Fax: 708-547-1608
   Email: sales@matot.com   Web Site: www.matot.com

B. Substitutions:
   1. Written request for Provisions of Spec Section 01600 “Material and Equipment”.

2.02 MATERIALS

A. General: Provide manufacture’s standard pre-engineered dumbwaiters. Where not otherwise indicated, provide manufacture’s product as indicated in published product literature and as required for complete dumbwaiter systems.

B. Systems and Machinery
1. Model shall be the Matot Dumbwaiter
2. Car shall have clear inside dimensions of
   a. Width: 24” inches wide
      Depth: 24” inches deep
      Height: 36” inches high.

C. Capacity to be 200 pounds.

D. Dumbwaiter to serve (2) two stops.

E. Dumbwaiter to have (2) two openings.

F. Opening configuration of the hoistway opposite opening.

G. The car shall stop at counter height loading

H. The travel distance shall be 13 feet 6 inches.

I. Nominal travel speed shall be 50 F.P.M.

J. Power supply shall be 208 volt, 3 Phase and 60 hertz.

2.03 Fabrication

A. Car Enclosure: The car shall be constructed of 16 gauge: #4 satin, polished stainless steel.
B. Car shall have one removable shelf.

C. An electrical light fixture shall be recessed in the ceiling.

D. Floor loading models shall have a reinforced floor.

E. Car Gates: The car shall be equipped on each open side with a gate matching the car construction and finish.
   1. The gate shall be vertical sliding design.
   2. Car gate(s) operation shall be manually operated.

F. Machine: Machine shall be Winding drum type.
1. Motor shall be of ample horsepower to lift the rated load at the rated speed, with a high starting torque and low starting current.
2. It shall be equipped with a spring applied and electrically released brake.
3. Machine shall be mounted on structural steel base and located at the bottom.

G. Hoistway Doors:
1. Vertical two panel bi-parting doors will be used. If project conditions do not allow sufficient clearances for bi-parting type, vertical single panel slide-up doors and/or swing doors will be provided.
2. Door(s) operation shall be manually operated.
3. Door finish shall be #4 satin polished stainless steel.
4. Each door shall bear the Underwriters “B” label for 1 ½ hours.
5. Hollow metal door panels and welded unit wall frame, including jambs, trim and sill shall be manufactured with 16 gauge material.
6. A door lock and contact or true interlock shall be provided on each door.

H. Machine Access Door: Hinged access door shall be 24” wide x 24” high and shall be furnished at machine location for service and maintenance.
1. Access door shall be 16 gauge carbon steel with a factory applied prime finish.

I. Guide Rails: Steel “Tee” rails or extruded aluminum rails shall be furnished to guide the car. Guide rails shall be mounted to the floor slabs and hoistway wall with steel or aluminum brackets.

J. Controller: Controller shall be a wall-mounted type with lockable door.
1. Location: On hoistway outer wall in sight of machine access door.
2. Characteristics: The controller shall be a solid state programmable and Underwriter’s Laboratories, Inc. listed.

K. Operational Control: Microprocessor controlled automatic call and send operation.
1. A pushbutton station with one button for each level served shall be furnished at each door. It shall be possible at each level to call the car or send it to any other level.
2. Pushbuttons shall be inoperative while car is in transit and for a few seconds after arrival at the selected level.
3. Pushbuttons shall have stainless steel faceplates.

L. Signals Devices:

1. “Door Open” call buzzer - shall sound when a pushbutton is pressed and a hoistway door or car gate is open.
2. “Car Here” light and chime - shall be located in each pushbutton station. Chime shall indicate car arrival. Light shall indicate car presence.
3. Combination “Door Open” and “In-Use” light - shall be located in each pushbutton station. Light will illuminate when car is in transit and when a pushbutton is pressed and a hoistway door or gate is open.
4. Door open/door close button shall be furnished if power operated hoistway doors are furnished.

M. Hoist Ropes. Minimum of one galvanized aircraft cable with safety factor per code.

N. Final Limit Stopping Devices: Provide per code

O. Guide Shoes: Guide shoes shall be adjustable, renewable dry type.

P. Counterweight: If the machine selected is a traction type a counterweight shall be provided and shall be equal in weight to that of the car plus 40% of the rated capacity.
A. The car and machine will have the ability to lift the rated load at a factor of 125% of capacity.

The car will travel within 10% +/- of the rated speed regardless of load or direction.

B. Leveling Accuracy: Car floor shall be no more than \( \frac{1}{4} \)" above or below the level of the hoistway door sill.

**Part 3 - Execution**

**3.01 Inspection**

A. Verify hoistway and openings are of correct size and within tolerance. Verify electrical power is available and of correct characteristics.

B. If preliminary work 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 ASME A17.1 Part 7 and the manufacturer's instructions including the following.

1. Leave manufacturers electrical connection drawings with electrical contractor to make final electrical connection.

2. The installation of the dumbwaiter shall be carried out in accordance with the approved plans and specifications and manufacture’s installation instructions.

3. Do not begin installation until preliminary work including hoistway, landings and machine space has been properly prepared.
5. Check hoistway for plumb and square.

3.04 Field Quality Control

A. Perform tests required by ASME A17.1

B. Supply instruments and execute specific tests.

C. Perform tests in presence of Owners Representative:
   1. Test dumbwaiter system by transporting the rated load up from main floor during thirty minute period.
   2. At an agreed time during contract warranty period, and with building normally occupied using normal building traffic, conduct tests to verify performance.
   3. Time dumbwaiter travel between typical floors at not more than the rated travel time.

3.05 Field Services

A. Obtain required permits to perform tests. Perform tests required by regulatory agencies. Schedule tests with agencies and Owners Representative and Contractor present.

B. Submit tests and approval certificates issued by jurisdictional authorities.

3.06 Adjusting and Cleaning

A. Adjust for smooth and quiet movement of car and doors. Adjust for consistent stopping at landings.

B. Remove protective coverings from finished surfaces. Clean surfaces and components ready for inspection.

3.07 Protection

A. Protect installed products until completion of project.
B. Touch-up, repair or replace damaged products before Substantial Completion.

3.08 Demonstration

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to operate the dumbwaiter.

END OF SECTION
SECTION 15010 - MECHANICAL GENERAL REQUIREMENTS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes mechanical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 01 Specification Sections.
1.3 INDUSTRY STANDARDS

A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference.

2. AASHTO - American Association of State Highway and Transportation Officials; www.transportation.org.
10. ASME - ASME International; (American Society of Mechanical Engineers); www.asme.org.
15. CDA - Copper Development Association; www.copper.org.
18. CSA - CSA International; (Formerly: IAS - International Approval Services); www.csa-international.org.
20. CTI - Cooling Technology Institute; (Formerly: Cooling Tower Institute); www.cti.org.
B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.

C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.

1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.
1.4 PERFORMANCE REQUIREMENTS

A. Systems Components Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

1.5 QUALITY ASSURANCE

A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the mechanical systems as specified and as indicated on Drawings.

1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.

B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of ASHRAE, NFPA, SMACNA and UL, unless otherwise indicated.

1. Notify the Architect/Engineer in writing before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations.

2. If the Contractor performs any work knowing it to be contrary to such laws, ordinances, rules and regulations, and without notice to A/E, the Contractor shall bear all costs arising from corrective measures.

C. Source Limitations: Obtain equipment and other components of the same or similar systems through one source from a single manufacturer.

D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the
latest accepted standards and practices for the trades involved.

F. Sequence and Schedule: Perform work to avoid interference with the work of other trades. Remove and relocate work which in the opinion of the Owner’s Representatives causes interference.

G. Labeling Requirement for Packaged Equipment: Electrical panels on packaged mechanical equipment shall bear UL label or label of other Nationally Recognized Testing Laboratory (NRTL) (Intertek, CSA, etc.).

1.6 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for Mechanical Work shall be secured and paid for by the Contractor. All Work shall conform to all applicable codes, rules and regulations.

B. Rules of local utility companies shall be complied with. Check with each utility company supplying service to the installation and determine all devices including, but not limited to, all valves, meter boxes, and meters which will be required and include the cost of all such items in proposal.

C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess of code requirements, the drawings and/or specifications shall govern.

D. Refer to Division 15 Section “Domestic Water Piping” for purchase and installation of potable water meters.

1.7 DRAWINGS

A. The drawings show the location and general arrangement of equipment, piping and related items. They shall be followed as closely as elements of the construction will permit.
B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly. Provide fittings, valves, and accessories as required to meet actual conditions.

C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The Architectural and Structural Drawings take precedence in all matters pertaining to the building structure, Mechanical Drawings in all matters pertaining to Mechanical Trades and Electrical Drawings in all matters pertaining to Electrical Trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.8 MATERIAL AND EQUIPMENT MANUFACTURERS

A. Equipment: All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of plumbing, heating, ventilating and air conditioning equipment and shall be the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but
not limited to, piping, sheet metal, electrical work, and building alterations shall be included in the original Bid.

C. All package unit equipment and skid mounted mechanical components that are factory assembled shall meet, in detail, the products named and specified within each section of the Mechanical and Electrical Specifications.

D. Changes Involving Electrical Work: The design of the mechanical systems is based on the equipment scheduled on the Drawings. Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified with no additional cost to project. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1. Where equipment changes are made that involve additional Electrical Work (larger size motor, additional wiring of equipment, etc.) the Mechanical Trades involved shall compensate the Electrical Trades for the cost of the additional Work required.

1.9 INSPECTION OF SITE

A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

B. No contract sum adjustments or contract time extensions will be made for Contractor claims arising from conditions which were or could have been observable, ascertainable or reasonably foreseeable from a site visit or inquiry into local conditions affecting the execution of the work.

1.10 ITEMS REQUIRING PRIOR APPROVAL

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents
must be submitted for review prior to bids. Such items must be submitted in compliance with Division 01 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.

2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, piping, sheet metal, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid, but will not affect the awarding of the contract.

1.11 SUBMITTALS

A. Submit project specific submittals for review in compliance with Division 01.

B. Prepare shop drawings to scale for the Architect/Engineer for review. Equipment and material submittals required are indicated in the Mechanical; Fire Suppression; Plumbing; and Heating, Ventilating and Air Conditioning Sections. Refer to Division 01 for submittal quantities.

C. All submittals shall be submitted in groupings of similar and/or related items. Plumbing fixture submittals shall be submitted as one package including all fixtures intended to be used for this project. Incomplete submittal groupings will be returned “Rejected”. Submit shop drawing with identification mark number or symbol numbers as specified or scheduled on the Mechanical Drawings.
D. All submittals shall be project specific. Standard detail drawings and schedule not clearly indicating which data is associated with this Project will be returned “Rejected”.

E. Shop drawings shall be reviewed by the Mechanical Contractor for completeness and accuracy prior to submitting to the Architect/Engineer for review. The shop drawings shall be dated and signed by the Mechanical Contractor prior to submission.

F. No equipment shall be shipped from stock or fabricated until shop drawings for them have been reviewed by the Architect/Engineer. Review is only for general conformance with the design concept of the project and general compliance with the information given in the Contract Documents. Any action indicated is subject to the requirement of the plans and specifications.

1. By the review of shop drawings, the Architect/Engineer does not assume responsibility for actual dimensions or for the fit of completed work in position, nor does such review relieve Mechanical Trades of full responsibility for the proper and correct execution of the work required.

2. Contractor is responsible for:
   a. Dimensions, which shall be confirmed and correlated at the job site.
   b. Fabrication processes and techniques of construction.
   c. Quantities.
   d. Coordination of Contractor’s work with all other trades.
   e. Satisfactory performance of Contractor’s work.
   f. Temporary aspects of the construction process.

G. Submit detailed shop drawings of piping systems showing pipe routing and types and locations of all pipe hangers.

H. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the project and the reasons therefore, shall be submitted with the submittal for approval.
1.12 COORDINATION DRAWINGS

A. Submit project specified coordination drawings for review in compliance with Division 01 Specification Sections.

1.13 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 01 Specification Sections.

B. Provide complete operation and maintenance instructional manuals covering all mechanical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. One copy of all manuals shall be furnished for Owner. Maintenance and operating instructional manuals shall be provided when construction is approximately 75 percent complete.

C. Format: Submit operations and maintenance manuals in the following format:


   a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.

   b. Enable inserted reviewer comments on draft submittals.

D. Operation and maintenance instructional manuals shall be submitted a minimum of four (4) weeks prior to functional testing.

E. The operating and maintenance instructions shall include a brief, general description for all mechanical systems including, but not limited to:

   1. Routine maintenance procedures.
   2. Lubrication chart listing all types of lubricants to be used for each piece of equipment and the recommended frequency of lubrication.
   3. Trouble-shooting procedures.
4. Contractor's telephone numbers for warranty repair service.
5. Submittals.
6. Recommended spare parts lists.
7. Names and telephone numbers of major material suppliers and subcontractors.
8. System schematic drawings.

1.14 RECORD DRAWINGS

A. Submit record drawings in compliance with Division 01.

B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media or vellum which have been neatly marked to represent as-built conditions for all new mechanical work.

C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

1.15 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of mechanical equipment and systems at agreed upon times. A minimum of 24 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

B. For equipment requiring seasonal operation, perform instructions for other seasons within six months.

C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

D. In addition to individual equipment training provide overview of each mechanical system. Utilize the as-built documents for this overview.
E. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction.

1.16 WARRANTY

A. Warranty: Comply with the requirements in Division 01 Specification Sections. Contractor shall warranty that the mechanical installation is free from defects and agrees to replace or repair, to the Owner’s satisfaction, any part of this mechanical installation which becomes defective within a period of one year (unless specified otherwise in other Mechanical; Fire Suppression; Plumbing; or Heating, Ventilating and Air Conditioning Sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

B. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

PART 2 - PRODUCTS

Not Applicable

PART 3 - EXECUTION

3.1 REFRIGERANT HANDLING

A. Refrigerant Installation and Disposal: Perform all work related to refrigerant contained in chillers, cooling coils, air conditioners, and similar equipment, including related piping, in strict accordance with the following requirements:

2. ASHRAE Standard 34 and Related Revisions: Number Designation and Safety Classification of Refrigerants.
3. United States Environmental Protection Agency (US EPA) requirements of Section 8 08 (Prohibition of Venting and Regulation of CFC) and applicable State and Local regulations of authorities having jurisdiction.
B. Recovered refrigerant is the property of the Contractor. Dispose of refrigerant legally, in accordance with applicable rules and regulations.

3.2 WORK INVOLVING OTHER TRADES

A. Certain items of equipment or materials specified in the Mechanical Division may have to be installed by other trades due to code requirements or union jurisdictional requirements. In such instances, the Contractor shall complete the work through an approved, qualified subcontractor and shall include the full cost for same in proposal.

3.3 ACCEPTANCE PROCEDURE

A. Upon successful completion of start-up and recalibration, but prior to building acceptance, substantial completion and commencement of warranties, the Architect/Engineer shall be requested in writing to observe the satisfactory operation of all mechanical control systems.

B. The Contractor shall demonstrate operation of equipment and control systems, including each individual component, to the Owner and Architect/Engineer.

C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect/Engineer for observation and approval.

D. After all items on the punch list are corrected and formal approval of the mechanical systems is provided by the Architect/Engineer, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

E. Operation of the following systems shall be demonstrated:

   1. Air Handling Systems.
   2. Refrigeration Systems.
   4. Domestic Hot Water Heaters.
   5. Domestic Hot Water Mixing Stations.
   6. Temperature Controls.
F. For systems requiring seasonal operation, demonstrate system performance within six months when weather conditions are suitable.

3.4 PROJECT COMMISSIONING

A. Refer to Division 01 “Project Commissioning” and the Commissioning Manual.

B. Purpose: Training, documentation and verification of the operation and functional performance of mechanical systems for compliance with the “design intent.”

END OF SECTION 15010
SECTION 15025 - VARIABLE FREQUENCY CONTROLLERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 01 specification sections, apply to work of this section.

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”
3. Division 15 Section “Motors.”

1.2 REFERENCES

A. ABMA 9 - Load Ratings and Fatigue Life for Ball Bearings.

B. ABMA 11 - Load Ratings and Fatigue Life for Roller Bearings.
C. ANSI/NEMA MG 1 - Motors and Generators.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. EMI: Electromagnetic interference.

C. LED: Light-emitting diode.

D. RFI: Radio-frequency interference.

E. THD: Total harmonic disturbance.

F. VFC: Variable frequency controller. Variable frequency controllers may also be referred to as variable speed drives, variable frequency drives, VSDs, or VFDs in other Specification Sections or on the Drawings.

1.4 SUBMITTALS

A. Product Data: For each type and rating of VFC indicated.
   1. Include dimensions and finishes for VFCs.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: Indicating power, control and instrument wiring including ladder diagrams for field work as well as factory assembled work. Manufacturer's drawings are acceptable only when modified and supplemented to reflect project conditions. The drawings shall include:
   1. Overall schematic (elementary) diagram in JIC form of the entire system of power and control circuitry. Indicate interfaces with control wiring by temperature controls contractor.
   2. Wiring diagrams showing the wiring layout of component assemblies or systems.
   3. Interconnection wiring diagrams showing terminations of interconnecting conductors between component assemblies, systems, control devices, and control panels complete with conductor identification, number of conductors, conductor and conduit size.
   4. Sequence of operation for components, assemblies or systems.
5. Dimensional data.

C. Product Certificates: For each VFC from manufacturer.


E. Coordination Data for Motor-Driven Equipment: Accompanied by complete information concerning the respective motors including the following.

1. Principal dimensions.
2. Weights.
3. Horsepower.
4. Voltage, phase, frequency.
5. Speed.
6. Class of insulation.
7. Enclosure type.
8. Frame.
9. Bearings including ABMA Rating Life (L-10 basis).
11. Manufacturer.
12. Service Factor

F. Descriptive data shall include catalogues, guaranteed performance data with efficiency and power factor indicated at 75 percent and 100 percent of rated load and verification of conformance with other requirements of the Contract Documents. The information enumerated under NEMA MG1 Paragraph MG1-10.38, shall be arranged on one sheet for each motor.

G. Operation and Maintenance Data: For VFCs to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Product Options for Restricted Space: Drawings indicate maximum dimensions for VFCs, including clearances between
VFCs, and adjacent surfaces and other items. Refer to Division 01 Section "Product Requirements."

C. 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.

D. Comply with NFPA 70.

E. Comply with IEEE 519 - Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store VFCs in permanently enclosed and conditioned spaces.

B. If stored in space that is not permanently enclosed and conditioned, remove loose packing and flammable materials from inside controllers and install temporary electric heating, with at least 250 W per controller.

1.7 COORDINATION

A. For Electrical Work Provided under Division 15 Specifications: Furnish UL Listed components, in accordance with Division 16 Specifications and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.

B. Provide Electrical Work required for the operation of components and assemblies provided as part of the Work under Division 15 Specifications.

C. Coordinate with temperature controls contractor for interfaces with temperature controls wiring.

D. Mount line voltage (120 VAC) control components specified as part of the Work under Division 15 Specifications.

E. Refer to ELECTRICAL DRAWINGS and Division 16 Specifications for specified information regarding provisions for the arrangement of electrical circuits and components and for interface with Work specified under Division 15 Specifications.
F. The mechanical contractor shall furnish and install the variable frequency controller. Electrical trades shall make power connections to both load and line side of the VFC.

1.8 WARRANTY

A. Warranty shall be 36 months from date of project acceptance. The warranty shall include all parts, labor, travel time and expenses.

PART 2 - PRODUCTS

2.1 GENERAL

A. Electrical Power Supply Characteristics: 208 volts, 3 phase, 60 hertz (Hz).

B. Controller(s) shall be suitable for use with standard NEMA-B squirrel-cage induction motor(s) having a 1.15 Service Factor. At any time in the future, it shall be possible to substitute standard motor (equivalent horsepower, voltage and RPM) in the field.

2.2 VARIABLE FREQUENCY CONTROLLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

1. ABB Group.
2. Danfoss.
5. Hitachi America, Ltd.
6. Johnson Controls Incorporated (Private labeled ABB).
7. Mitsubishi Electric Automation, Inc.
8. Square D; Schneider Electric.
10. Yaskawa Electric America, Inc.

B. Provide variable frequency controllers as scheduled including bypass starter, coasting motor restart, and step over frequency.

1. The ratio of the total impedance to common system impedance shall be greater than or equal to 10.
2. The voltage notch area shall be limited to 16-400 volt microseconds.
3. The total harmonic disturbance (THD) as a result of voltage notching shall be 3 percent or less at the point of common coupling.
4. The THD as a result of current notching shall be 100 percent or less at the point of common coupling.

C. Provide 3 percent AC input line reactors sized appropriate for each current rating variable frequency controller.

D. Variable frequency controller (VFC) shall comply with all applicable provisions of the National Electrical Code.

E. Line side of the VFC shall have a displacement power factor of 0.95 or greater when motor is operating at 50 to 100 percent motor speed.

F. VFC shall have efficiency greater than 85 percent when motor is operating at 50 to 100 percent motor speed.

G. Design and Rating: Match load type, such as fans, blowers, and pumps; and type of connection used between motor and load such as direct or through a power-transmission connection.

H. Unit Operating Requirements:
   1. Input AC Voltage Tolerance: Plus 10 and minus 5 percent of VFC input voltage rating.
   2. Input Frequency Tolerance: Plus 2 percent of VFC frequency rating.

I. Each variable frequency controller shall consist of an adjustable frequency converter which shall convert input power into an adjustable frequency output in an ambient temperature of zero to 40 deg C. Output power shall be suitable capacity and waveform to provide stepless speed control of the specified horsepower motor throughout the required speed range under variable torque load not exceeding the motor's full-load rating.

J. Provide fault detection and trip circuits to protect itself and the connected motor against line voltage transients, power line under voltage, output overvoltage and overcurrent. A disconnect with padlockable door
interlocked external handle shall be supplied to disconnect the incoming power.

a. Minimum SCCR according to UL 508 shall be as required by electrical power distribution system, but not less than 65,000 A.

b. Minimum short circuit design shall be in accordance with Electrical Contractor provided short circuit analysis.

K. Minimum output frequency shall be the lowest frequency at which the connected motor can be operated without overheating.

L. Inverter shall contain current limiting circuitry, adjustable to 100 percent of motor full-load current to provide soft start, acceleration, and running without exceeding motor rated current. The current limit circuit shall be of the type for variable torque load, which acts to diminish output frequency while limiting, without directly causing shutdown.

M. Automatic Reset/Restart: Attempt three restarts after drive fault or on return of power after an interruption and before shutting down for manual reset or fault correction; adjustable delay time between restart attempts. For safety, drive shall shut down and require manual reset and restart if automatic reset/restart function is not successful within three attempts.

N. Bidirectional Autospeed Search: Capable of starting VFC into rotating loads spinning in either direction and returning motor to set speed in proper direction, without causing damage to drive, motor, or load.

O. Isolate signal circuits from the power circuits and design to accept a speed signal from a remote process controller in the automatic mode and from the speed control potentiometer in the manual mode. A door-mounted switch shall provide mode selection. The selected signal shall control the motor speed between the adjustable minimum and maximum speed settings. Maximum speed shall be field adjustable to 100 percent of rated speed. The speed signal shall follow a linear time ramp, adjustable from 4-20 seconds to provide acceleration from zero to minimum speed. When minimum speed is reached, the speed signal
shall follow the linear time ramp for acceleration and deceleration control.

P. Mount the adjustable frequency inverter and other electrical components that provide the operation specified in a NEMA 1 enclosure. Equipment shall have external heat sinks, or air filters on all vents. The enclosure shall have hinged front access doors with latch. Cabinet to cabinet interconnecting wiring shall be factory dressed, tagged and harnessed, and shipped with one end attached.

Q. Controller shall have the ability to step-over certain set frequencies that may cause a system to resonate. The controller shall have at least two manually set points of frequency in which the controller shall step-over during operation.

R. Operating and monitoring devices for the inverter shall be door mounted and shall include the following:

1. Manual Speed Control to set speed in the hand (manual) mode.
2. Speed indicating meter, either in revolutions per minute, proportional to the applied frequency and voltage to indicate speed of the converter-powered motor or frequency (hertz).
3. VFC "fault/reset" pilot light pushbutton combination with dry contact for external alarm. Fault alarm shall not actuate upon normal shutdown.
4. Inverter "control power" indicator.
5. Motor "running" indicator and two dry contacts that close when motor is running.
6. Output current meter calibrated in "AC amps."
7. Operating selector switches and indicating light to perform the following functions:
   a. One hand-off-auto switch for the VFC and bypass starter with indicating lights (red-running, green-energized). In hand position, unit (VFC or bypass starter) shall start. In auto position, unit (VFC or bypass starter) shall start when remote dry contact is closed.
   b. Unit shall be capable of being padlocked in the off position.
   c. Variable frequency bypass selector switch with indicating lights. In bypass position, contactors
and interlocks shall be positioned to run unit directly from 208 VAC line voltage when the H-O-A selector switch is in hand or auto position.

8. Output voltmeter (0 - 600 VAC) (analog or digital).

S. The VFC is to be provided with isolated 4-20 mA DC output signals proportional to speed, current and voltage for connection by others.

T. The VFC shall be provided with the ability to communicate (monitoring) through RS485 connector.

U. Remote speed control shall be a 3-15 psig pneumatic signal from a remote controller. Provide a pressure transducer in the VFC enclosure to convert the pneumatic signal to an electrical signal for automatic speed control.

V. Remote speed control shall be 4-20 mA control signal from a remote controller.

W. Manual bypass starter shall be as follows:

1. Single-Speed Nonreversing Starter: Consisting of a full voltage magnetic starter with two convertible auxiliary contacts, thermal overloads, control transformer and control devices as indicated and as specified, all mounted and wired in a separate sectioned part of VFC enclosure.

2. Interlocking: Equip switch with an external operating handle. Interlock the operating handle such that the door cannot be opened unless the switch is in the "off" position. Provide means for padlocking the operating handle in the "off" position with three 5/16 inch shackles padlocks such that when the operating handle is padlocked in the "off" position, the cover door cannot be opened and the switch cannot be closed.

3. Starter: Size starters per the horsepower of the motors with which they will be used, except do not furnish starters smaller than NEMA Size 1 for motors of 5 horsepower or less. Provide coils for operation on 120 volts AC unless other requirements are indicated. Equip each starter with a minimum of two convertible auxiliary contacts in addition to the normally-open seal-in contact, unless additional requirements are indicated. Provide additional contacts as indicated.
4. Thermal Overload: One in each phase wire, manual reset type. Select overloads after final installed horsepower of motor is determined. Do not use ratings exceeding 100 percent of motor full load current adjusted for ambient temperatures.

5. Control Transformer: Provide a 208-120 volt control transformer in the starter enclosure. Fuse and ground the secondary winding as indicated. Where indicating lights or other control components are to be energized from the control transformer, increase the capacity of the control transformer to 200 VA.

6. Bypass/VFC starter shall consist of 3 contactors or have a drive disconnect as well as a main disconnect for isolation purposes.

X. Variable frequency controller shall not cause motor to produce noise levels exceeding 80 dBA measured at a distance of 3 feet from the motor. If noise level of motor exceeds this amount, the contractor shall be responsible for correcting the problem.

Y. Provide connection points for system safety controls such as smoke detectors, freeze stats, damper end switches, etc. as shown on mechanical temperature control drawings. Opening of a contact on safety controls wired to the drive shall shut down the motor(s) in both the VFC and bypass mode.

Z. VFCs specified on the drawings to have contactor motor selection, in order to operate "either one or both" motors connected to the VFC, shall have the separate motors controlled by horse power rated contactors. These contactors shall be capable of being controlled locally (by a switch in the panel door) or remotely. The contactors shall also have two convertible auxiliary contacts in order to sense contactor position.

AA. VFCs specified on the drawings to operate "either" motor with contactor motor selection shall have separate horse power rated contactors to control each motor.

BB. The contactors shall be interlocked in order that only one motor may run at a time. These contactors shall be capable of being controlled locally (by a switch in the panel door) or remotely. The contactors shall also have two
convertible auxiliary contacts in order to sense contactor position.

CC. Provide in each VFC, a relay, that upon loss of the automatic speed control signal shall:

1. Automatically shut down the motor.

DD. Coordinate with the Temperature Controls Contractor for the interface of control wiring to the drive as required to meet the requirements of the temperature control drawings. Drive shall be furnished with internal control wiring configured in the factory to allow single connections of field wiring to terminal blocks in the drive by the Temperature Controls Contractor.

EE. All indicating lights shall be push to test or LED.

2.3 SOURCE QUALITY CONTROL

A. Factory Tests: The controller shall be subject to, but not limited to, the following quality assurance controls, procedures and tests:

1. Power transistors, SCRs and diodes shall be tested to ensure correct function and highest reliability.
2. All printed circuit boards shall be tested at 50 deg C for 50 hours. The VFC manufacturer shall provide certification that the tests have been completed.
3. Every controller will be functionally tested with a motor to ensure that if the drive is started up according to the instruction manual provided, the unit will run properly.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, surfaces, and substrates to receive VFCs, with Installer present, for compliance with requirements for installation tolerances, and other conditions affecting performance.

B. Examine VFC before installation. Reject VFCs that are wet, moisture damaged, or mold damaged.
C. Examine roughing-in for conduit systems to verify actual locations of conduit connections before VFC installation.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install and adjust materials and equipment in accordance with the manufacturer's instructions.

B. Obtain the manufacturer's instructions for materials and equipment provided under the Contract in detail necessary to comply with the requirements of the Contract Documents.

C. If unit is free standing, provide a concrete housekeeping pad.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Upon completion of each installation, conduct complete acceptance tests in the presence of duly notified authorities having jurisdiction and the Owner to demonstrate component, assembly or system performance in accordance with the requirements of the Contract Documents.

C. In the event that a test demonstrates that a component assembly or system performance is deficient, the Owner may require additional tests after corrective work.

D. Prepare test and inspection reports, including a certified report that identifies the VFC and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations made after remedial action.

E. Component assembly and systems acceptance is predicated upon completion of specified work and receipt by the Owner of data specified under "Submittals."
F. Electrical testing of motors is specified in Division 15 Section “Motors.”

3.4 ADJUSTING

A. Program microprocessors for required operational sequences, status indications, alarms, event recording, and display features. Clear events memory after final acceptance testing and prior to Substantial Completion.

B. Set field-adjustable switches, auxiliary relays, time-delay relays, timers, and overload-relay pickup and trip ranges.

C. Adjust the trip settings of instantaneous-only circuit breakers and thermal-magnetic circuit breakers with adjustable, instantaneous trip elements. Initially adjust to 6 times the motor nameplate full-load amperes and attempt to start motors several times, allowing for motor cool-down between starts. If tripping occurs on motor inrush, adjust settings in increments until motors start without tripping. Do not exceed 8 times the motor full-load amperes (or 11 times for NEMA Premium Efficient motors if required). Where these maximum settings do not allow starting of a motor, notify Construction Manager before increasing settings.

D. Set the taps on reduced-voltage autotransformer controllers.

E. Set field-adjustable circuit-breaker trip ranges.

F. Set field-adjustable pressure switches.

3.5 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions until controllers are ready to be energized and placed into service.

B. Replace VFCs whose interiors have been exposed to water or other liquids prior to Substantial Completion.
3.6 DEMONSTRATION

A. The VFC supplier/support group shall provide the following additional services:

1. On-site training of customer personnel in operation and maintenance of variable frequency controllers.
2. Provide four copies of a troubleshooting manual and factory training manuals to help the building operator determine what steps must be taken to correct any problem that may exist in the system.
3. Coordinate enrollment of customer personnel in factory-held service schools.

END OF SECTION 15025
SECTION 15050 - BASIC MECHANICAL MATERIALS AND METHODS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Domestic Water Piping” for flushing and cleaning of potable water piping.
3. Division 15 Section “Piping Systems Flushing and Chemical Cleaning” for flushing and cleaning of HVAC piping.

1.2 SUMMARY

A. This section includes mechanical materials and installation methods common to mechanical piping systems, sheetmetal systems and equipment. This section supplements all other Division 13 Fire Protection Sections, Division 15 Mechanical Sections, and Division 01 Specification Sections.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic.
   5. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
   6. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

C. Brazing Certificates: As required by ASME Boiler and Pressure Vessel Code, Section IX, or AWS B2.2.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

B. Comply with NSF 14, "Plastics Piping System Components and Related Materials," for plastic, potable domestic water
piping and components. Include marking "NSF-pw" on piping.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," for potable domestic water piping and components.

D. Comply with NSF 372, "Drinking Water System Components - Lead Content" for potable domestic water piping and components.

E. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

F. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.


I. Installer Qualifications:

1. Installers of Grooved Components: Installers shall be certified by the grooved component manufacturer as having been trained and qualified to join piping with grooved couplings, fittings, and specialties.
2. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.
3. Fiberglass Pipe and Fitting Installers: Installers of RTRF and RTRP shall be certified by the manufacturer of pipes and fittings as having been trained and
qualified to join fiberglass piping with manufacturer-recommended adhesive.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Provide adequate weather protected storage space for all mechanical equipment and materials deliveries to the job site. Storage locations will be designated by the Owner’s Representative. Equipment stored in unprotected areas must be provided with temporary protection.

1. Protect equipment and materials from theft, injury or damage.
2. Protect equipment outlets, pipe and duct openings with temporary plugs or caps.
3. Materials with enamel or glaze surface shall be protected from damage by covering and/or coating as recommended in bulletin “Handling and Care of Enamel Iron Plumbing Fixtures”, issued by the Plumbing Fixtures Manufacturer Association, and as approved.
4. Electrical equipment furnished by Mechanical Trades and installed by the Electrical Trades: Turn over to Electrical Trades in good condition, receive written confirmation of same.
5. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations. Coordinate with other trades to ensure accurate locations and sizes of mechanical spaces, chases, slots, shafts, recesses and openings.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Install Work to avoid interference with work of other trades including, but not limited to, Architectural and
Electrical Trades. Remove and relocate any work that causes an interference at Contractor's expense.

D. Coordinate requirements for and provide access panels and doors for mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

E. The mechanical trades shall be responsible for all damage to other work caused by their work or through the neglect of their workers.

1. All patching and repair of any such damaged work shall be performed by the trades which installed the work. The cost shall be paid by the Mechanical Trades.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 15 piping Sections for special joining materials not listed below.

B. Unions: Pipe Size 2 Inches and Smaller:

1. Ferrous pipe: Malleable iron ground joint type unions.
2. Unions in galvanized piping system shall be galvanized.
3. Copper tube and pipe: Bronze unions with soldered joints.

C. Flanges: Pipe Sizes 2-1/2 Inch and Larger:
   2. Copper tube and pipe: Slip-on bronze flanges.

D. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

E. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated. Square head bolts and nuts are not acceptable.

F. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

G. Solder Filler Metals: ASTM B 32, lead-free, antimony-free, silver-bearing alloys. Include water-flushable flux according to ASTM B 813.

H. Brazing Filler Metals: Alloys meeting AWS A5.8.
   1. Use Type BcuP Series, silver-bearing, copper-phosphorus alloys for joining copper or bronze socket fittings with copper pipe. Flux is prohibited unless used with bronze fittings.
   2. Use Type Bag Series, cadmium-free silver alloys for joining copper with steel, stainless steel, or other ferrous alloys.

J. Welding Materials: Comply with Section II, Part C, of ASME Boiler and Pressure Vessel Code for welding materials appropriate for wall thickness and for chemical analysis of pipe being welded.

2.4 PIPE THREAD COMPOUNDS

A. Pipe thread compounds for the fluid service compatible with piping materials provided.

B. Compounds for potable water service and similar applications acceptable to U.S. Department of Agriculture (USDA) or Food and Drug Administration (FDA). Compounds containing lead are prohibited.

C. Inorganic zinc-rich coatings or corrosion inhibited proprietary compounds for galvanized carbon steel systems to coat raw carbon steel surfaces, in lieu of subsequent painting.

1. Manufacturers:
   a. Carboline "Carbo-Zinc 12."
   b. Tnemec.
   c. Koppers.

D. Graphite and oil or proprietary corrosion inhibited compounds suitable for system temperatures for steam or condensate.

1. Manufacturers:
   a. WKM; Division of Cooper Industries, Inc., Key "Graphite Paste."
   b. Other approved.

E. Use tetrafluoroethylene (Teflon) tape 2 to 3 mils thick for natural gas system threaded joints.

1. Manufacturers:
   b. Permacel.
c. Other approved.

2.5 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Manufacturers:
   b. Dresser Industries, Inc.; DMD Div.
   c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
   d. JCM Industries.
   e. Smith-Blair, Inc.
   f. Viking Johnson.

2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
4. Aboveground Pressure Piping: Pipe fitting.

B. Flexible Transition Couplings for Underground Nonpressure Drainage Piping: ASTM C 1173 with elastomeric sleeve, ends same size as piping to be joined, and corrosion-resistant metal band on each end.

1. Manufacturers:
   b. Fernco, Inc.
   d. Plastic Oddities, Inc.
   e. Can-Tex Industries Division of Harsco Corp. “CT-Adaptors”.
   f. Joint Inc., “Caulder”.

2.6 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Brass Unions, Brass Nipples, Brass Couplings: For systems up to 286 deg F.

D. Dielectric-Flange Kits: Include full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

1. Manufacturers:
   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Capitol Manufacturing Co.
   d. Central Plastics Company.
   e. Epco Sales, Inc.
   f. Pipeline Seal and Insulator, Inc.
   g. Watts Water Technologies, Inc.; Watts Regulator Co.
   h. Zurn Industries, Inc.; Wilkins Div.

2. Separate companion flanges and steel bolts and nuts shall have 150-psig minimum working pressure where required to suit system pressures.

E. Dielectric Nipple/Waterway Fittings: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, male NPT threaded, or grooved ends; and 300-psig minimum working pressure at 230 deg F.

1. Manufacturers:
   b. Elster Group; Perfection Corp.; ClearFlow.
   d. Sioux Chief Manufacturing Co., Inc.
   e. Tyco Fire & Building Products; Grinnell Mechanical Products; Figure 407 ClearFlow.
   f. Victaulic Co. of America; Style 47 ClearFlow.

2.7 MODULAR MECHANICAL SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve or pipe and core drilled hole.
1. Manufacturers:
   b. Calpico, Inc.
   c. Metraflex Co.
   d. Pipeline Seal and Insulator, Inc.; Thunderline Link Seal.

2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Carbon steel. Include two for each sealing element.

4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 SLEEVES

A. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall black.

B. Steel Pipe: ASTM A53, Type E, Grade B, Schedule 40, and 0.375 inch wall galvanized, plain ends.

2.9 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

1. New Piping:
   a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
   b. Chrome-Plated Piping or Piping in High Humidity Areas: One-piece, cast-brass type with polished chrome-plated finish.
   c. Insulated Piping: One-piece, stamped-steel type with spring clips.
   d. Bare Piping in Finished Spaces: One-piece, stamped-steel type.
   e. Bare Piping in Unfinished Service Spaces or Equipment Rooms: Split-plate, stamped-steel type with concealed hinge and set screw.
2. Existing Piping: Use the following:
   a. Chrome-Plated Piping or Piping in High Humidity Areas: Split-casting, cast-brass type with chrome-plated finish.
   b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
   c. Bare Piping: Split-plate, stamped-steel type with set screw or spring clips.

2.10 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi, 28-day compressive strength.

2.11 EPOXY BONDING COMPOUND

A. Two-component system suitable for bonding wet or dry concrete to each other and to other materials.

B. Manufacturers:
   1. Euco 452 #450; Euclid Chemical Co.
   2. Epobond; L & M Construction Chemicals.
   3. Sikadur 87; Sika Corp.

2.12 LEAK DETECTOR SOLUTION

A. Commercial leak detector solution for pipe system testing.

B. Manufacturers:

2.13 PIPE ROOF PENETRATION ENCLOSURES

A. Manufacturers:
   1. Pate Company (The).
   2. Portals Plus, Inc.
3. Thybar Corporation; Thycurb.

B. Minimum 18 gage welded galvanized steel construction.

C. Integral base plate.

D. Built-in fully mitered cant.

E. Factory installed insect and decay resistant wood nailer.

F. Factory installed 1-1/2 inch thick, 3 pounds per cubic foot density rigid insulation.

G. EPDM compression molded rubber cap for single or multiple pipes as required.

H. Stainless steel draw-band clamps.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Refer to piping application schedules on the Drawings.

B. Install piping according to the following requirements and Division 15 Sections specifying piping systems, and in accordance with manufacturer’s instructions.

C. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. The Drawings shall be followed as closely as elements of construction will permit.

D. During the progress of construction, protect open ends of pipe, fittings, and valves to prevent the admission of foreign matter. Place plugs or flanges in the ends of all installed work whenever work stops. Plugs shall be commercially manufactured products.

E. Prior to and during laying of pipe, maintain excavations dry and clear of water and extraneous materials. Provide minimum 4 inches of clearance in all directions for pipe passing under or through building grade beams.

F. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and
thermal wells in steel pipe. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

G. Brazolets can be used for annular flow measuring devices, temperature control components, and thermal wells in copper tube. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

H. Clean and lubricate elastomer joints prior to assembly.

I. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.

J. Install piping to conserve building space and not interfere with use of space.

K. Group piping whenever practical at common elevations.

L. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

1. Install piping to allow for expansion and contraction at locations where piping crosses building or structure expansion joints.

M. Slope piping and arrange systems to drain at low points.

N. Slope horizontal piping containing noncondensible gases 1 inch per 100 feet, upward in the direction of the flow.

O. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

P. 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.

Q. In concealed locations where piping, other than black steel, cast-iron, or galvanized steel, is installed through holes or notches in studs, joists, rafters or similar members less than 1-1/2 inches from the nearest edge of the member, the pipe shall be protected by shield plates. Protective shield plates shall be a minimum of 1/16 inch thick steel, shall cover the area of the pipe where the member is notched or bored, and shall extend a
minimum of 2 inches above sole plates and below top plates.

R. Do not penetrate building structural members unless specifically indicated on drawings.

S. Install piping above accessible ceilings to allow sufficient space for ceiling panel and light fixture removal.

T. Install valves with stems upright or horizontal, not inverted.

U. Provide clearance for installation of insulation and access to valves and fittings.

V. Install piping to permit valve and equipment servicing. Do not install piping below valves and/or terminal equipment. Do not install piping above electrical equipment.

W. Install piping at indicated slopes. Provide drain valves with hose end connections and caps at all piping low points, where piping is trapped and at all equipment.

X. Install piping free of sags and bends.

Y. Install fittings for changes in direction and branch connections.

Z. Unless otherwise indicated or specified, install branch connections to mains using tee fittings in main pipe:

1. Branch connected to bottom of main pipe for HVAC systems. Side connection is acceptable. Connection above centerline of main is unacceptable.
2. Branch connected to top of main for plumbing systems.

AA. Install piping to allow application of insulation.

BB. Select system components with pressure rating equal to or greater than system operating pressure.

CC. After completion, fill, clean, and treat systems. Refer to Division 15 Sections “Hydronic Piping,” “Piping Systems Flushing and Chemical Cleaning,” and “HVAC Water Treatment.”
DD. Install escutcheons for penetrations of walls below ceiling, and ceilings.

EE. Sleeves are not required for core-drilled holes in poured concrete walls.

FF. Permanent sleeves are not required for holes formed by removable PE sleeves in poured concrete walls.

GG. Install sleeves for pipes passing through footings and foundation walls, masonry walls, gypsum-board partitions, and concrete floor and roof slabs.

1. Cut sleeves to length for mounting flush with both surfaces of walls.
   a. Exception: Extend sleeves installed in floors 2 inches above finished floor level.

2. Install sleeves in new walls and slabs as new walls and slabs are constructed.

3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
   a. Schedule 40 Black Steel Sleeves: For pipes smaller than NPS 12 penetrating interior walls.
   b. 0.375 Inch Wall Black Steel Sleeves: For pipes NPS 12 and larger penetrating interior walls.
   c. Schedule 40 Galvanized Steel Sleeves: For pipes smaller than NPS 12 penetrating floors, and roof slabs.
   d. 0.375 Inch Wall Galvanized Steel Sleeves: For pipes NPS 12 and larger penetrating floors and roof slabs.
   e. For pipes penetrating floors with membrane waterproofing provide cast iron sleeve with clamping flanges. Secure/seal membrane to sleeves with clamping flanges.

4. Seal sleeves in concrete floors roof slabs and masonry walls with grout.

5. Seal sleeves in plaster/gypsumboard partitions with plaster or dry wall compound and caulk with non-hardening silicone sealant to provide airtight installation.
6. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

HH. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.

1. Install Schedule 40 galvanized steel pipe for sleeves smaller than 12 inches in diameter.
2. Install 0.375 galvanized steel pipe for sleeves 12 inches and larger in diameter.
3. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

II. New, Poured Concrete, Underground, Exterior-Wall and Slab on Grade Pipe Penetrations: Install water stop sleeves prior to pour. Seal pipe penetrations using modular mechanical seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing modular mechanical seals.

1. Modular Mechanical Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble modular mechanical seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

JJ. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

1. Seal openings around pipes in sleeves through walls, floors and ceilings, and where floors, fire rated walls and smoke barriers are penetrated. Firestop
materials shall be UL listed and shall have a fire rating equal to or greater than the penetrated barrier.

2. Refer to Division 07 Specification Sections for materials and UL Classified firestop systems.

KK. Pipe Roof Penetration Enclosures:

1. Coordinate delivery of roof penetration enclosures to jobsite.
2. Locate and set curbs on roof.
3. Framing, flashing, and attachment to roof structure are specified under Division 07.
4. Attach cap to curbs, cut pipe boots to fit pipe, and clamp boots to pipe or conduit.

LL. Verify final equipment locations for roughing-in.

MM. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 Sections specifying piping systems.

B. Cut piping square.

C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

D. Remove scale, slag, dirt, oil, and debris from inside and outside of pipe and fittings before assembly.

E. Clean damaged galvanized surfaces and touch-up with a zinc rich coating.

F. Use standard long sweep pipe fittings for changes in direction. No mitered joints or field fabricated pipe bends will be permitted. Short radius elbows may be used where specified or specifically authorized by the Architect.

G. Make tee connections with screwed tee fittings, soldered fittings or specified welded connections. Make welded branch connections with either welding tees or forged
branch outlet fittings in accordance with ASTM A234, ANSI B16.9 and ANSI B16.11. For forged branch outlets, furnish forged fittings flared for improved flow where attached to the run, reinforced against external strains and to full pipe-bursting strength requirements. "Fishmouth" connections are not acceptable.

H. Use eccentric reducers for drainage and venting of pipe lines; bushings are not permitted.

I. Provide pipe openings using fittings for all systems control devices, thermometers, gauges, etc. Drilling and tapping of pipe wall for connections is prohibited.

J. Provide temperature sensing device thermal wells and similar piping specialty connections.

K. Provide instrument connections except thermal wells with specified isolating valves at point of connection to system.

L. Locate instrument connections in accordance with manufacturer’s instructions for accurate read-out of function sensed. Locate instrument connections for easy reading and service of devices.

M. 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."

N. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter.

O. 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.
P. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

1. Weld-o-lets and thread-o-lets can be used for annular flow measuring devices, temperature control components, and thermal wells. Pipe taps shall be drilled and deburred. Torch cutting is not acceptable.

Q. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on gaskets and bolt threads.

1. Assemble flanged joints with fresh-stock gasket and hex head nuts, bolts or studs. Make clearance between flange faces such that the connections can be gasketed and bolted tight without strain on the piping system. Align flange faces parallel and bores concentric; center gaskets on the flange faces without projection into the bore.

2. Lubricate bolts before assembly to insure uniform bolt stressing. Draw up and tighten bolts in staggered sequence to prevent unequal gasket compression and deformation of the flanges. Do not mate a flange with a raised face to a companion flange with a flat face; machine the raised face down to a smooth matching surface and use a full face gasket. After the piping system has been tested and is in service at its maximum temperature, check bolting torque to provide required gasket stress.

R. Grooved Joints: Assemble joints with grooved-end-pipe or grooved-end-tube coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Galvanized piping shall be cut grooved to prevent damage to galvanizing on internal pipe surfaces. The grooved coupling manufacturer’s factory trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools, application of groove, and installation of grooved joint products. The manufacturer’s representative shall periodically visit the jobsite and review installation.
Contractor shall remove and replace any joints deemed improperly installed.

S. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.

T. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

U. Dissimilar-Metal Piping Joints: Construct joints using dielectric fittings compatible with both piping materials. Refer to Application Schedules on the Drawings.

V. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D 2235 and ASTM D 2661 Appendixes.
   3. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   4. 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.
   5. PVC Nonpressure Piping: Join according to ASTM D 2855.
   6. PVC to ABS Nonpressure Transition Fittings: Join according to ASTM D 3138 Appendix.

W. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

X. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

Y. Remake joints which fail pressure tests with new materials including pipe, fittings, gaskets and/or a filler.

3.3 ACCESS DOORS

A. Provide access doors for installation by architectural trades. Provide access doors in the walls, as required to make all valves, controls, coils, motors, air vents,
filters, electrical boxes and other equipment installed by the Contractor accessible. Minimum size 12 inches x 12 inches. Provide access doors in the ceiling, for accessibility as mentioned above, 24 inches x 24 inches minimum size. Areas with accessible ceilings (ceilings where lay-in panels are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors. Refer to Division 08 Section "Access Doors and Frames" for manufacturers and model numbers and additional information.

B. When access doors are in fire resistant walls or ceilings, they shall bear the Underwriters’ Laboratories, Inc., Label, with time design rating equal to or greater than the wall or ceiling unless they were a part of the tested assembly.

3.4 EQUIPMENT CONNECTIONS

A. Make connections to equipment, fixtures, and other items included in the work in accordance with the submittals and rough-in measurements furnished by the manufacturers of the particular equipment furnished.

1. Any and all additional connections not shown on the drawings but shown on the equipment manufacturer’s submittal or required for the successful operation of the equipment shall be installed as part of this Contract at no additional charge to the Owner.

B. All piping connections to pumps, coils, and other equipment shall be installed without strain at the pipe connection of this equipment. When directed, remove the bolts in flanged connections or disconnect piping to demonstrate that piping has been so connected.

3.5 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.

2. Install flanges, in piping NPS 2-1/2 and larger, where indicated on Drawings, at final connection to each piece of equipment and at all control valves.
3.6 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated. Housekeeping pad locations and sizes shall be coordinated by mechanical contractor prior to the placement of concrete slabs.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

E. For suspended equipment, furnish and install all inserts, rods, structural steel frames, brackets and platforms required. Obtain approval of Architect for same including loads, locations and methods of attachment.

F. Equipment Rigging Over Roof Areas: Protect building structure against damage during equipment rigging. Make provisions to distribute load of equipment to main roof structure, and to prevent damage to roof decking, roofing, or purlins.

G. The Contract Documents indicate items to be purchased and installed. The items are noted by a manufacturer’s name, catalog number and/or brief description. The catalog number may not designate all the accessory parts for a particular application. Arrange with the manufacturer for the purchase of all items required for a complete installation.

3.7 PAINTING

A. Painting of mechanical systems, equipment, and components is specified in Division 09.
B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.8 CONCRETE BASES

A. Concrete housekeeping pads for floor mounted mechanical equipment shall be provided by Architectural Trades.

B. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.

1. Construct concrete bases as shown on Drawings or specified, but not less than 4 inches larger in both directions than supported unit.

2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.

3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.

4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.

6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section.

3.9 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Refer to Division 05 Section "Metal Fabrications" for structural steel.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

C. Where pipe and/or equipment support members must be welded to structural building framing, Contractor shall seek prior approval from Architect and structural engineer.
Scrape, brush clean, and apply one coat of zinc rich primer after welding.

D. Field Welding: Comply with AWS D1.1.

3.10 JACKING OF PIPE

A. Do not jack pipe in place except upon prior approval of proposed materials and complete details of methods.

3.11 GROUTING

A. Mix and install grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.12 CUTTING, CORING AND PATCHING

A. Refer to Division 01 Specification Sections for requirements for cutting, coring, patching and refinishing work necessary for the installation of mechanical work.

B. All cutting, coring, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.13 EXCAVATION AND BACKFILLING

A. Refer to Division 02 Specification Sections.

B. Provide all excavation, trenching, tunneling and backfilling required for the mechanical work.
C. Provide all pumping and/or well pointing required for the mechanical work.

D. Provide foundations if required to support underground piping.

E. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

3.14 FLASHING

A. Provide all flashing required for mechanical work. Refer to Division 07 Specification Sections.

3.15 LUBRICATION

A. Provide all lubrication for the operation of the equipment until acceptance by the Owner. Contractor is responsible for all damage to bearings up to the date of acceptance of the equipment. Protect all bearings and shafts during installation. Thoroughly grease steel shafts to prevent corrosion. Provide covers as required for proper protection of all motors and other equipment during construction.

3.16 FILTERS

A. Provide and maintain filters in air handling systems throughout the construction period and prior to final acceptance of the building. Do not run air handling equipment, without all prefilters and final filters as specified.

B. Immediately prior to final building acceptance by the Owner, Contractor shall:

1. Replace all disposable type air filters with new units.
3.17 CLEANING

A. Each Mechanical Trade shall be responsible for removing all debris daily as required to maintain the work area in a neat, orderly condition.

B. After equipment, steam, condensate and HVAC water piping systems have been completed and tested, each entire system shall be cleaned and flushed. Refer to Division 15 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.

C. Prior to connection of new HVAC piping to existing HVAC piping systems, all new piping shall be subject to initial flushing, cleaning and final flushing. Refer to Division 15 Section "Piping Systems Flushing and Chemical Cleaning" for requirements. Provide temporary bypass piping and fittings, temporary valves and strainers, temporary water make-up piping with approved means of backflow prevention, and temporary pumps as needed to perform specified flushing and cleaning requirements.

D. Flushing, cleaning, and disinfection of domestic water piping is specified in Division 15 Section “Domestic Water Piping.”

E. Exterior surfaces of all piping, ductwork and equipment shall be wiped down to remove excess dirt and debris prior to concealment by Architectural Trades work.

F. Upon completion of work in each respective area, clean and protect work. Just prior to final acceptance, perform additional cleaning as necessary to provide clean equipment and areas to the Owner.

END OF SECTION 15050
SECTION 15053 - COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

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

B. Related Sections include the following:
   1. Division 15 Section “Mechanical General Requirements.”
   2. Division 15 Section “Basic Mechanical Materials and Methods.”
   3. Division 15 Section “Testing, Adjusting, and Balancing.”
1.2 SUMMARY

A. This Section includes common requirements for fans and air moving equipment.

1.3 SUBMITTALS

A. Product Data: For the following:
   1. Fan bearings.
   2. V-belt fan drives.
   3. Direct drive couplings.

1.4 QUALITY ASSURANCE

A. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.


C. Sound Power Level Ratings:
   1. Ducted Fans - Rated per AMCA 301, when tested per AMCA 300.
   2. Nonducted Fans - Rated in Zones at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not operate equipment for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 FAN SHAFTS

A. Fan Shafts: Ground from solid cold rolled steel, and proportioned to run at least 25 percent below the first critical speed.

2.3 FAN POWER TRANSMISSION


B. A given manufacturer's V-belt drive, as applied to specific equipment provided under the Contract, shall conform to the equipment manufacturer's published recommendations, except as otherwise specified.

C. Base horsepower rating of drive on minimum pitch diameter of small sheave.

D. Locate belt drives outboard of bearings. Align drive and driven shafts by the four-point method.

E. Adjust belt tension in accordance with the manufacturer's recommendations.

F. Perform alignment and final belt tensioning in the presence of the Architect.

2.4 SHEAVES

A. Furnish sheaves of machined cast iron or carbon steel, bushing type of fixed bore, secured to the shaft by key and keyway.

B. For all constant speed fans at or above 2 inches of total static pressure, Contractor shall provide and install two sets of fixed sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after system balance is complete and shall be based on actual field conditions.
C. For all constant speed fans below 2 inches total static pressure, Contractor shall provide and install two sets of adjustable sheaves. First set shall be installed for initial start-up and shall be based on scheduled data. The second set shall be installed after the balance is complete and shall be based on actual field conditions, and selected at mid-range of the sheave.

D. Set pitch diameters of fixed pitch and adjustable or variable pitch sheaves when adjusted as specified, at not less than that recommended by NEMA Standard MG1-14.42.

E. For companion sheaves for adjustable or variable pitch drives, furnish wide groove spacing to match driving sheaves.

F. For all variable frequency controller (VFC) operated fans, contractor shall provide and install one set of fixed sheaves sized to allow full utilization of fan motor horsepower provided, with VFC at 100 percent of fan motor RPM.

2.5 V-BELT FAN DRIVES

A. Fan Drives: Multiple V-belt style with adjustable pitch driver sheaves for fans up to 2 inches of total static pressure and fixed pitch driver sheaves for fans at or above 2 inches of total static pressure and up. Sheaves shall have split, taper style bushings. Drives shall be selected for a 150 percent service factor and shall provide for adjustment of both belt tension and alignment.

B. Manufacturers:

1. Emerson Power Transmission; Browning.
2. Rockwell Automation; Dodge.
3. T.B. Wood’s Incorporated.

2.6 FAN DRIVE, SHAFT, AND COUPLING GUARDS

A. Safety Provisions: Include guards and screens for power transmission equipment, but do not negate vibration isolation provision.

B. Furnish ANSI and OSHA compliant mechanical power transmission apparatus guards except where superseded by other governing codes, and except as modified and
supplemented. Requirements specified apply to all types of fans.

C. Fabricate mechanical power transmission device guards such that the completed structure is capable of withstanding a load of at least 200 pounds applied in any direction.

D. Furnish a guard enclosure for each V-belt drive, coupling, shaft, and rotating component. Secure guards in place, easily removable for maintenance. Guard fasteners used for maintenance access shall be "captive type." Locate holes on each guard for tachometer readings on both the motor and fan shafts. Fabricate guard of minimum 16 gage sheet metal with hemmed edges at openings for shafts. Weld four mounting lugs or feet of 10 gage material to the guard. Fabricate guards for couplings five inches in diameter and larger of 12 gage sheet metal. Furnish holes in mounting feet sized for suitable machine screws.

E. Centrifugal exhaust fans shall be provided with shaft seals.

2.7 BELT DRIVE GUARDS

A. Belt Guards: ANSI and OSHA compliant with provision for readily viewing belt tension and measuring shaft speeds. Guards shall be installed with quick release pins, so that removal of three to five clip pins, will allow the guard to be removed from fan housing.

B. Fabricate guards which completely enclose moving parts of the particular drive. Design and construct guards of such rigidity as to contain a belt which breaks during operation. Minimum material thickness, 16 gage sheet metal. Where ventilation is required, perforated metal shall be used for the sides. Fabricate top of solid sheet metal.

2.8 V-BELTS

A. Notched or cogged style, endless type, of Dacron reinforced elastomer construction, with cross-section to suit sheave grooves. Determine the number of V-belts from the motor horsepower to which apply the service factor to obtain the design horsepower. Determine the corrected horsepower per belt by multiplying the nominal horsepower per belt by an arc of contact factor not greater than
0.85. Divide the design horsepower by the corrected horsepower per belt to obtain the number of belts required. In any case, furnish not less than two belts for each drive.

B. Furnish belts that have been factory or factory-authorized distributor matched and measured on a belt-matching machine. Selection by "code numbers," "sag numbers" or "match numbers" is not acceptable. Bind each belt set with wire and tag with equipment identification.

C. Manufacturers:

1. Emerson Power Transmission; Browning; AX, BX, and CX Series and 3VX and 5VX Series.
2. Rockwell Automation; Dodge; Classic Cog and Narrow Cog V-Belts.
3. T.B. Wood’s Incorporated; Classical Cog and Narrow Cog V-Belts.

2.9 V-BELT DRIVE MOTOR BASES

A. Furnish fan motors with slide or adjustable pivoted bases wherever equipment configuration permits proper installation.

B. Provide for adjustment of both belt tension and alignment.

2.10 AIR HANDLING SYSTEM BALANCING PROVISIONS

A. Provide extra sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each air handling system during air quantity balancing operations. Furnish sheaves as specified in this Section.

B. Provide sheaves, sized as recommended by the Balancing Agent, for the adjustment of fan speed for each existing air handling system requiring rebalancing during air quantity balancing operations. Furnish sheaves as specified in this Section.

2.11 FLEXIBLE COUPLINGS (DIRECT DRIVE)

A. Fan shaft shall be connected to the motor shaft through a flexible coupling. The flexible member shall be a tire shape, in shear, or a solid mass serrated edge disc shape, made of chloroprene materials and retained by fixed
flanges. Flexible coupling shall act as a dielectric connector and shall not transmit sound, vibration or end thrust.

B. Manufacturer:

1. Falk Corporation (The).

2.12 MOTOR REQUIREMENTS

A. Furnish motors in accordance with Division 15 Section "Motors."

2.13 FAN BEARINGS

A. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with ABMA L₁₀ minimum life of 200,000 hours. Use cast iron housings and dust-tight seals suitable for lubricant pressures.

1. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe maintenance while equipment is operating. Provide manual or automatic pressure relief fittings to prevent overheating or seal blow-out due to excess lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.

2. Bearings on Equipment with less than 1/2 horsepower rating or on shafts smaller than 1-3/4 inch in diameter: Permanently sealed, pre-lubricated anti-friction bearings per specified materials and ABMA L₁₀ life requirements.

2.14 IDENTIFICATION

A. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.

2.15 ACCESSORIES

A. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each nonducted fan.
2.16 ROOFTOP EQUIPMENT ENCLOSURES

A. Description: Louvered or corrugated, direct attached screening system as selected by the Architect.

1. Manufacturers:
   a. Spinnaker Industries Inc.

B. Mounts directly to mechanical equipment and requires no roof penetration.

C. Sliding panels provide access to equipment compartments for service and maintenance.

D. Rated to withstand lateral forces developed due to wind speeds of 225 mph.

E. Baked on polyester powder coat finish meeting ASTM B-117 standard for 500 hour salt spray.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.

B. Install sheaves where recommended by Testing, Adjusting, and Balancing agency.

C. Refer to individual Division 15 HVAC equipment Sections for additional requirements.

END OF SECTION 15053
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 “Mechanical General Requirements.”
2. Division 15 Section "Mechanical Vibration Controls" for mounting motors and vibration isolation devices.
3. Division 15 Section “Variable Frequency Controllers”.
4. Division 15 Sections for application of motors and reference to specific motor requirements for motor-driven equipment.
5. Division 16 Section “Enclosed Switches and Circuit Breakers”.

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6. Division 16 Section “Enclosed Controllers”.
7. Division 16 Section “Fuses”.

1.2 SUMMARY

A. This Section includes basic requirements for factory-installed motors.

1.3 DEFINITIONS

A. ABMA: American Bearing Manufacturers Association. (Formerly AFBMA: Anti-Friction Bearing Manufacturers Association.)

B. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

C. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.

D. Packaged Self Contained Equipment: Equipment which includes component mechanical and electrical equipment mounted on common bases, skids or frames or in common enclosures with internal control and power wiring factory installed and ready to accept a single electrical service connection. Provide the equipment complete with enclosed controllers, main disconnect switches, control transformers, control devices, wiring and accessories as required.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL), acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect motors stored on site from weather and moisture by maintaining factory covers and suitable weather-proof covering. For extended outdoor storage, remove motors from equipment and store separately.

1.6 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices. Provide motors that are:

1. Compatible with the following:
   a. Magnetic controllers.
   b. Multispeed controllers.
   c. Reduced-voltage controllers.
   d. Solid-state controllers.
   e. Variable frequency controllers.

2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.

3. Matched to torque and horsepower requirements of the load.

4. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate electrical scope of work to be provided by Division 15 with this Section, related Division 15 Specifications, Division 16 Specifications and the Drawings.

C. Electrical work provided under Division 15: Furnish UL Listed components in accordance with this section, Division 16, and applicable NEMA and NEC (ANSI C 1) requirements. Provide wiring, external to electrical enclosures, in conduit.

D. Furnished, installed and wired under Division 15 unless otherwise indicated:

1. Disconnected components in packaged self-contained equipment that are so constructed that components of wiring must be disconnected for shipment and reconnected after installation.
E. Furnished and installed under Division 15 and wired under Division 16 unless otherwise indicated:

1. Motors required for mechanical equipment
2. Packaged Self-Contained Equipment:
   a. Provide equipment ready to accept a single electrical service connection.
   b. For equipment with remote mounted control panels, provide mounting of the control panel and external wiring from the control panel to the package self-contained equipment.

3. Variable frequency controllers.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Quantity equal to 10 percent of each fuse type and size, but no fewer than 3 of each type and size.
2. Spare Indicating Lights: Six of each type installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Dayton.
2. Toshiba Intl.
7. Regal Beloit/Leeson.
8. Regal Beloit/Marathon.
9. Siemens.

2.2 MOTOR REQUIREMENTS

A. Motor requirements apply to factory-installed motors except as follows:
1. Different ratings, performance, or characteristics for a motor are specified in another Section.

2. Manufacturer for a factory-installed motor requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

3. Submersible motors integral to pumps and excluded from NEMA and EISA standards.

B. Electrical Power Supply Characteristics: Coordinate electrical system requirements with Division 16.


D. Electrical Connection: Conduit connection boxes, threaded for conduit. For fractional horsepower motors where connection is made directly, provide screwed conduit connection in end frame.

2.3 MOTOR CHARACTERISTICS

A. Motors 1/2 HP and Larger: Three phase, unless otherwise indicated.

B. Motors Smaller Than 1/2 HP: Single phase, unless otherwise indicated.

C. Frequency Rating: 60 Hz.

D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.

E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.

F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.

G. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

H. Brake Horsepower Input: Shall not exceed 90 percent of the rated motor horsepower.
I. Enclosure: Open dripproof (ODP) for motors installed indoors and out of the airstream. Totally-enclosed fan-cooled (TEFC) for motors installed outdoors or within the airstream.

2.4 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Fire pump motors, C-face motors, JP and JM frame motors, and motors over 200 horsepower shall be energy efficient motors. Efficiency of the motor shall be determined based on the NEMA MG1. The minimum efficiencies, nominal efficiencies and shall meet or exceed Table 12-11.

<table>
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<tr>
<th>HP</th>
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1200 RPM

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<td>85.5</td>
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C. Efficiency: Motors 1 horsepower to 200 horsepower shall be premium efficient motors meeting requirements of NEMA Premium Efficiency Motor Program. Efficiency of the motor shall be determined based on the NEMA MG1. The nominal efficiencies shall meet or exceed Table 12-12.

Nominal Efficiencies For “NEMA Premium™” Induction Motors Rated 600 Volts or Less (Random Wound)

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D. Stator: Copper windings, unless otherwise indicated.

1. Multispeed motors shall have separate winding for each speed.

E. Rotor: Squirrel cage, unless otherwise indicated.
F. Bearings: Grease lubricated anti-friction ball bearings with housings equipped with plugged provision for relubrication, rated for minimum ABMA 9, L-10 life of 120,000 hours. Calculate bearing load with NEMA minimum V-belt pulley with belt center line at end of NEMA standard shaft extension. Stamp bearing sizes on nameplate.

G. Temperature Rise: Match insulation rating, unless otherwise indicated.

H. Insulation: Class F, unless otherwise indicated.

I. Code Letter Designation:

1. Motors 10 HP and Larger: NEMA starting Code (KVA Code) F or G.
2. Motors Smaller Than 10 HP: Manufacturer's standard starting characteristic.
3. Fire Pump Motors: NEMA starting Code (KVA Code) B.

J. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.

1. Finish: Gray enamel.

K. Sound Level: Not to exceed NEMA MG-1 12.54.

2.5 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
C. Shaft Grounding: Provide a means to protect motor from common mode currents.

1. Required for:
   a. Motors used with variable frequency controllers.
   b. Motors 100 HP and larger.

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

D. Severe-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with nonhygroscopic material.

1. Finish: Chemical-resistant paint over corrosion-resistant primer.

E. Source Quality Control: Perform the following tests on each motor according to NEMA MG 1:

1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

2.6 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device
shall automatically reset when motor temperature returns to normal range.

D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

2.7 ENCLOSED CONTROLLERS

A. Provide enclosed controllers in accordance with requirements specified in Division 16 Section “Enclosed Controllers”.

2.8 ENCLOSED SWITCHES AND CIRCUIT BREAKERS

A. Provide enclosed switches and circuit breakers in accordance with requirements specified in Division 16 Section “Enclosed Switches and Circuit Breakers”.

2.9 FUSES

A. Provide fuses in accordance with requirements specified in Division 16 Section “Fuses”.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

A. All three phase motors 1/2 HP and above shall be tested by the Testing Agency.

B. Prepare for acceptance tests as follows:

1. Check motor nameplates for horsepower, speed, phase and voltage.
2. Check coupling alignment and shaft end play.
3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
4. Test interlocks and control features for proper operation.
5. Verify that current in each phase is within nameplate rating.

C. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:
D. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

E. Testing: Perform the following field quality-control testing:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.15.1. Certify compliance with test parameters.
2. Jog motor as required to verify proper phase and shaft rotation. Immediately after start-up, check bearing temperature and smooth operation. Take current reading at full load using a clamp-on ammeter. If ammeter reading is over the rated full load current, determine reason for discrepancy and take necessary corrective actions. Record all readings, motor nameplate data and overload heater data.
3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.2 ADJUSTING

A. Align motors, bases, shafts, pulleys and belts. Tension belts according to manufacturer's written instructions.

3.3 CLEANING

A. After completing equipment installation, inspect unit components. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean motors, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 15055
SECTION 15060 - HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Division 13 Section "Fire-Suppression Piping" for pipe hangers for fire-protection piping.
3. Division 15 Section “Mechanical General Requirements.”
4. Division 15 Section “Basic Mechanical Materials and Methods.”
5. Division 15 Section "Pipe Expansion Fittings and Loops" for pipe guides and anchors.
6. Division 15 Section(s) "Metal Ducts" and "Nonmetal Ducts" for duct hangers and supports.

1.2 DEFINITIONS
A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.
B. MFMA: Metal Framing Manufacturers Association.

1.3 PERFORMANCE REQUIREMENTS
A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.4 SUBMITTALS
A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
B. Welding certificates.

1.5 QUALITY ASSURANCE
A. MSS Standards: Pipe hangers, supports, and accessories shall comply with the following:
   1. MSS SP-58, Pipe Hangers and Supports – Materials, Design and Manufacture.
   2. MSS SP-69, Pipe Hangers and Supports – Selection and Application.
   3. MSS SP-89, Pipe Hangers and Supports – Fabrication and Installation Practices.
B. Welding: Qualify procedures and personnel according to the following:

1. AWS D1.1, "Structural Welding Code--Steel."
4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 HANGER ROD MATERIAL

A. Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575.

1. Rod continuously threaded.
2. Use of rod couplings is prohibited.

2.3 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-69, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article, and schedules and details on the Drawings for where to use specific hanger and support types.

1. Hangers and Supports for Fire Protection Piping: UL listed or FMG approved.

B. Manufacturers:

1. Anvil International, Inc.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. Hilti USA.
5. ERICO International Corp.
6. PHD Manufacturing, Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.4 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.5 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

2. B-Line by Eaton.
4. Unistrut Corp.; Tyco International, Ltd.
5. Hilti USA.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

E. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.6 METAL INSULATION SHIELDS

A. Manufacturers:

1. Anvil International, Inc.
2. B-Line by Eaton.
3. Carpenter & Paterson, Inc.
4. ERICO International Corp.
5. PHD Manufacturing, Inc.

B. Description: MSS SP-69, Type 40, protective shields. Shields shall span an arc of 180 degrees.

C. Shield Dimensions for Pipe: Not less than the following:
   1. NPS 1/4 to NPS 2: 12 inches long and 0.048 inch thick.

2.7 PIPE COVERING PROTECTION SADDLES

A. Manufacturers:
   1. Anvil International, Inc.
   2. B-Line by Eaton.
   3. Carpenter & Paterson, Inc.
   4. ERICO International Corp.
   5. PHD Manufacturing, Inc.

B. Description: MSS SP-69, Type 39A and Type 39B, for suspension of insulated hot pipe where heat losses are to be kept to a minimum.
   1. Saddles shall match insulation thickness.
   2. Saddle length: 12 inches.
   3. Furnish with center rib for pipe sized NPS 12 and larger.

2.8 PLASTIC INSULATION SHIELDS

A. Manufacturers:
   1. B-Line by Eaton; Snap’N Shield.
   2. Hydra-Zorb Company; Bronco.

B. Description: Polypropylene copolymer protective shields designed to snap directly onto strut channel. Shields shall span an arc of 180 degrees.
   1. Operating Temperature Range: Minus 40 deg F to plus 178 deg F.

C. Certifications:
   1. UL Classified for USA: UL-723 (ASTM E 84).
   2. UL listed for Canada: ULC-S102.2.
   3. Meets UL94 HB flammability standards.
D. Shield Dimensions for Pipe: Not less than the following:

1. NPS 1/4 to NPS 2: 12 inches long.

2.9 THERMAL-HANGER SHIELDS

A. Manufacturers:

2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
5. ERICO International Corp.
6. Value Engineered Products, Inc.

B. Description: Manufactured assembly consisting of insulation insert encased in 360 degree sheet metal shield.

1. Minimum Compressive Strength of Insert Material:
   a. 100-psig- for sizes smaller than NPS 6.
   b. 600-psig- for sizes NPS 6 and larger.

C. Insulation-Insert Material for Cold Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Full 360 degree, water-repellent treated, ASTM C 533, Type I calcium silicate.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

F. Include carbon steel ASTM A36 load distribution plates as required by load, pipe movement, hanger style, and hanger spacing.

G. Thermal-Hanger Shields for Flexible Foamed Elastomeric Insulated Piping:

1. Manufacturer:
   a. B-Line by Eaton/Armacell; Armafix IPH.
2. Insulation-Insert Material for Copper Piping with Flexible Foamed Elastomeric Insulation: Use the following:
   a. Flexible foamed elastomeric, ASTM 534, Type I-Tubular Grade 1 with PUR/PIP support inserts.

H. Thermal-Hanger Shields for Small Diameter Piping:

1. Manufacturer:
   a. Hydra-Zorb Company; Klo-Shure Insulation Couplings.

2. Insulation-Insert Material for Small Diameter Piping with Flexible Foamed Elastomeric or Glass Fiber Insulation: Use the following:
   a. Rigid Hytrel thermoplastic insulation coupling designed for use with pipe or tube NPS 4 and smaller, and insulation from 3/8 inch to 1-1/2 inch thick.

2.10 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Manufacturers:
   b. Empire Industries, Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head.
   e. MKT Fastening, LLC.
   f. Powers Fasteners.

B. Threaded Inserts: Galvanized malleable iron or galvanized steel for 3/4 inch bolts.

1. Manufacturers:
   a. Superior Concrete Accessories; Threaded Insert.
   b. Dayton Sure-Grip and Shore Co.
   c. Richmond Screw Anchor Co.
2.11 ROOF MOUNTED PIPING SUPPORTS

A. Pipe Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Low, Fixed-Height, Single-Base Stand: Assembly of base and horizontal member, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:
   a. B-Line by Eaton; Dura-Blok.
   b. Eco Support Products.
   c. ERICO International Corp.
   d. MIRO Industries; Conduit and Condensate Supports.
   e. Portable Pipe Hangers.

2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.

C. Low, Adjustable-Height, Single-Base Stand: Assembly of base, horizontal member, and adjustable vertical members, and pipe support, for roof installation without membrane penetration.

1. Manufacturers:
   a. B-Line by Eaton; Dura-Blok.
   b. Eco Support Products.
   c. ERICO International Corp.
   d. MIRO Industries; Conduit and Condensate Supports.
   e. Portable Pipe Hangers.

2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.

D. High, Adjustable-Height, Single-Base Stand: Assembly of base, horizontal member, and adjustable vertical members,
and clevis type pipe support, for roof installation without membrane penetration.

1. Manufacturers:
   a. B-Line by Eaton; Dura-Blok.
   b. Eco Support Products.
   c. ERICO International Corp.
   d. MIRO Industries; Water and Steam Supports.
   e. Portable Pipe Hangers.

2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.
4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.

E. Low, Fixed-Height, Single-Base Roller Stand: Assembly of base and horizontal roller, for roof installation without membrane penetration.

1. Manufacturers:
   a. B-Line by Eaton; Dura-Blok.
   b. Eco Support Products.
   c. ERICO International Corp.
   d. MIRO Industries; Gas and Mechanical Supports.
   e. Portable Pipe Hangers.

2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.

F. Low, Adjustable-Height, Single-Base Roller Stand: Assembly of base and horizontal roller, for roof installation without membrane penetration.

1. Manufacturers:
   a. B-Line by Eaton; Dura-Blok.
   b. Eco Support Products.
   c. ERICO International Corp.
   d. MIRO Industries; Gas and Mechanical Supports.
   e. Portable Pipe Hangers.
2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel rod and corrosion resistant roller designed for use with standard accessories.
4. Vertical Members: Threaded, hot rolled, steel rod conforming to ASTM A 36 or A575 with cadmium plated nuts and washers. Rod continuously threaded.

G. High, Multiple-Base Pipe Stand: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

1. Manufacturer:
   a. B-Line by Eaton; Dura-Blok.
   b. Eco Support Products.
   c. ERICO International Corp.
   d. MIRO Industries; Water and Steam Supports.
   e. Portable Pipe Hangers.

2. Bases: Two or more plastic, steel, or recycled rubber.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

2.12 ROOF MOUNTED EQUIPMENT SUPPORTS

A. Equipment Stands, General: Shop or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted equipment.

B. Non-Penetrating Equipment Supports: Assembly of two or more bases and horizontal members, for roof installation without membrane penetration.

1. Manufacturers:
   a. B-Line by Eaton; Dura-Blok.
   b. Eco Support Products.
   c. ERICO International Corp.
   d. MIRO Industries; HD and LD Mechanical Unit Supports.
   e. Portable Pipe Hangers.

2. Base: Plastic, stainless steel, or recycled rubber.
3. Horizontal Member: Cadmium-plated-steel, galvanized-steel, or stainless steel strut, and planking; designed for use with standard strut clamps, all-thread rood, and accessories.


1. Roof Rail Type Supports: Coordinate installation and type with Architectural Trades. Top shall be level and extend a minimum of 10 inches above top of roof insulation.

a. Manufacturers:

   1) Pate.
   2) Thybar; TEMS Series.
   3) Roof Products and Systems.
   4) Greenheck.
   5) Creative Metals.

2.13 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.14 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, 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, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Refer to application schedules on the Drawings.
B. For insulated pipe, oversize hanger elements to accommodate insulation thickness.

C. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

D. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

E. Use hangers and supports with galvanized, metallic coatings for outdoor applications or where exposed to outdoor conditions.

F. Use hangers and supports with plastic coating, or galvanized metallic coatings for applications in corrosive atmospheres.

G. Use metal framing, with plastic coating, or galvanized metallic coatings for metal framing in corrosive atmospheres.

H. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

I. Use padded hangers for piping that is subject to scratching.

J. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. MSS Type 8 or spring type to meet system requirements.

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.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

L. Steel Frame Structure Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Beam Clamps:
   a. Center Loading: TYPE 21, 28, 29 and 30, unless otherwise indicated. Type 27 shall be allowed to support single pipes NPS 6 size or smaller only.
   b. "C" Clamps: Type 19, 20 or 23, for supporting single pipes NPS 2-1/2 size or smaller only. Use of "C" clamps, or beam clamps of "C" pattern, or any modification thereof, is prohibited for supporting multiple pipes or pipes larger than NPS 2-1/2.

M. Hanger-Rod Attachments for Wood Construction: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. All Steel Ceiling Plates: UL listed and suitable for attachment to wood beams. For pipe sizes NPS 1/2 to NPS 2. Install in accordance with manufacturer’s instructions to maintain listing.
2. Threaded Side Beam Brackets: UL listed and FMG approved, suitable for attachment to wood beams. For pipe sizes NPS 2 to NPS 4. Install in accordance with manufacturer’s instructions to maintain listing.

N. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Use spring supports and sway braces TYPES 48, 49, 50, 51, 52, 53, 54, 55 or 56. For specific points:
   a. Provide spring supports at point of support where vertical movement will occur.
   b. For light loads and vertical movement less than 1/4 inch, TYPES 48 or 49 spring cushion supports.
   c. For vertical movements in excess of 1/4 inch but less than 1/2 inch, TYPES 51, 52 or 53 variable spring supports shall be used, loaded to not more than 75 percent of published load rating.
d. For vertical movements of 1/2 inch and more, TYPES 54, 55 and 56 constant support spring hangers.
e. Sway braces; TYPE 50.
f. Variable spring hangers in accordance with referenced MSS Standards with "medium" allowable load change.

O. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

P. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel 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 building structural frame.

B. Provide necessary piping and equipment supporting elements including: building structure attachments, supplementary steel, hanger rods, stanchions and fixtures, vertical pipe attachments, horizontal pipe attachments, anchors, guides, spring supports in accordance with the referenced codes, standards, and requirements specified. Support piping and equipment from building structure, not from roof deck, floor slab, other pipe, duct or equipment.

C. At connections between piping systems, hangers and equipment of dissimilar metals, insulate, using dielectric insulating material, nonferrous piping against direct contact with the building steel by insulating the contact point of the hanger and pipe or the hanger and building steel. Test each point of dielectric insulation with an ohm meter to ensure proper isolation of dissimilar materials. Test shall be observed by the Owner's Representative and/or Architect.

D. Use copper plated or plastic coated supporting element in contact with copper tubing or glass piping.

E. File and paint cut ends and shop or field prime paint supporting element components.
F. Hang piping parallel with the lines of the building, unless otherwise indicated. Route piping in an orderly manner and maintain gradient. Space piping and components so a threaded pipe fitting may be removed between adjacent pipes and so there will be not less than 1/2 inch of clear space between finished surfaces and piping. Arrange hangers on adjacent parallel service lines in line with each other.

G. Flange loads on connected equipment shall not exceed 75 percent of maximum allowed by equipment manufacturer. Flange loads in liquid containing systems shall be checked in the presence of the Architect when piping is full of liquid. No flange load is allowed on pumps, vibration isolated equipment or flexible connectors.

H. Spring supports, within specified limitations: Constant support type, where necessary to avoid transfer of load from support to support or onto connected equipment; otherwise, variable support type located at points subject to vertical movement.

I. Incorporate pipe anchors into piping systems to maintain permanent pipe positions. Install alignment guides for the piping adjacent to and on each side of pipe expansion loops and expansion joints to maintain alignment.

J. Where necessary, brace piping and supports against reaction, sway and vibration.

K. Do not hang piping from floor decks, roof decks, equipment, ductwork, or other piping.

L. Install turnbuckles, swing eyes and clevises to accommodate temperature changes, pipe accessibility, and adjustment for load pitch. Rod couplings are not acceptable.

M. Install hangers and supports for piping at intervals specified, at locations not more than 3 feet from the ends of each runout, not more than 3 feet from connections to equipment, and not over 25 percent of specified interval from each change in direction of piping and for concentrated loads such as valves, etc.
N. Base the load rating for pipe support elements on loads imposed by insulated weight of pipe filled with water. The span deflection shall not exceed slope gradient of pipe.

O. If structural steel, roofs, or tunnels will allow support spacing greater than that shown above, Contractor shall submit proposed support system along with structural calculations documenting the allowance of such spacing, in accordance with ANSI, B31.1, and MSS Guidelines.

P. Support vertical risers independently of connected horizontal piping whenever practical, with supports at the base and at intervals to accommodate system range of load with thermal conditions. Support vertical risers at each floor penetration for piping in shafts or chases. Guide for lateral stability. Fit horizontal piping connected to moving risers with two spring supports connected adjacent to riser, spaced according to required hanger spacing.

Q. For risers at temperatures of 100 deg F or less place riser clamps under fittings. Support carbon steel pipe at each operating level or floor and at not more than 15-foot intervals for pipe 2 inches and smaller, and at not more than 20 foot intervals for pipe 2-1/2 inches and larger.

R. After the piping systems have been installed, tested and placed in satisfactory operation, firmly tighten hanger rod nut and jam nut and upset threads to prevent movement of fasteners.

S. Attach pipe anchors and pipe alignment guides to the building structure where indicated. If not indicated, the method used is optional to the Contractor, subject to approval by the Architect. In the case of structural steel, make attachment by clamping in accordance with the American Institute of Steel Construction Specification for the Design, Fabrication and Erection of Structural Steel for Building.

T. Attach supporting elements connected to structural steel columns to preclude vertical slippage and cascading failure.

U. Attach pipe hangers and other supporting elements to roof purlins and trusses at panel points.
V. Where eccentric loading beam clamps are approved and where other work is supported by similar eccentric loading support element from the same structural member, locate eccentric loading support elements to minimize structural member torsion load.

W. Limit the location of supporting elements for piping and equipment, when supported from roof, to panel points of the bar joists.

X. Building structure shall not be reinforced except as approved by the Architect in writing.

Y. 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 above for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D1.1.

Z. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

AA. Fastener System Installation:

1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

BB. Roof-Mounting Pipe and Equipment Stand Installation:

1. Stand Types except Curb-Mounting Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.

2. Curb or Rail Mounting Type Stands: Assemble components or fabricate stand and mount on permanent, stationary roof curb or rail. Refer to Division 07 Section "Roof Accessories" for curb and rail installation.

3. Maintain support manufacturer’s recommended spacing.
CC. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.


EE. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

FF. Install lateral bracing with pipe hangers and supports to prevent swaying.

GG. 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.

HH. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

II. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

JJ. Refer to individual piping sections for hanger spacing and hanger rod sizes.

3.3 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 smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.
3.4 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 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 contours of welded surfaces match adjacent contours.

3.5 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.

3.6 PAINTING

A. Touch Up: 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 minimum dry film thickness of 2.0 mils.

B. Equipment Supports: Painting is specified in Division 09 painting Sections.
C. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09 painting Sections.

D. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 15060
PART 1 - GENERAL

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

B. Related Sections include the following:
   1. Division 15 Section “Mechanical General Requirements.”
   2. Division 15 Section “Basic Mechanical Materials and Methods.”

1.2 SUBMITTALS
A. Product Data: Include load deflection curves for each vibration isolation device.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Include the following:
1. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.

2. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, and spring deflection changes. Include certification that riser system has been examined for excessive stress and that none will exist.

3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, base weights, equipment static loads, power transmission, component misalignment, and cantilever loads.

C. Welding certificates.

1.3 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code--Steel."

1.4 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into base. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. Installation of these items is specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 VIBRATION ISOLATION EQUIPMENT BASES

A. **Type A**: Direct Isolator Attachment

1. Unit to be isolated is so constructed that vibration isolators of the type specified may be directly attached, provided that the edge deflection of the isolated unit base over unsupported span between mountings does not exceed specified or manufacturer's limits. If units to be isolated will not meet required deflection provisions, Type B bases shall be provided.
B. **Type B**: Factory-fabricated, welded, structural-steel bases or rails.

1. **Structural Steel Bases**:

   a. **Basis-of-Design Product**: Subject to compliance with requirements, provide Mason Industries, Inc.; Type WF or a comparable product by one of the following:

      1) Amber/Booth; a VMC Group Company.
      2) Kinetics Noise Control, Inc.
      3) Korfund Dynamics; a VMC Group Company.
      4) Vibration Eliminator Co., Inc.
      5) Vibration Isolation Co., Inc. (Pump Bases Only)
      6) Vibration Mountings & Controls; a VMC Group Company.
      7) Vibro-Acoustics.

   b. **Design Requirements**: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.

   c. **Structural Steel**: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

   d. **Support Brackets**: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

2. **Structural-Steel Rails**:

   a. **Basis-of-Design Product**: Subject to compliance with requirements, provide Mason Industries, Inc.; Type ICS or a comparable product by one of the following:

      1) Amber/Booth; a VMC Group Company.
      2) Kinetics Noise Control, Inc.
      3) Korfund Dynamics; a VMC Group Company.
      4) Vibration Eliminator Co., Inc.
      5) Vibration Isolation Co., Inc. (Pump Bases Only)
6) Vibration Mountings & Controls; a VMC Group Company.
7) Vibro-Acoustics.

b. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.

c. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.

d. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

C. Type C Inertia Base: Factory-fabricated, welded, structural-steel bases and rails ready for field-applied, cast-in-place concrete.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type BMK/KSL or a comparable product by one of the following:

   1) Amber/Booth; a VMC Group Company.
   2) Kinetics Noise Control, Inc.
   3) Korfund Dynamics; a VMC Group Company.
   4) Vibration Eliminator Co., Inc.
   5) Vibration Isolation Co., Inc. (Pump Bases Only)
   6) Vibration Mountings & Controls; a VMC Group Company.
   7) Vibro-Acoustics.

2. Design Requirements: Lowest possible mounting height with not less than 1-inch clearance above the floor. Include equipment anchor bolts and auxiliary motor slide bases or rails. Include supports for suction and discharge elbows for pumps.

3. Structural Steel: Steel shapes, plates, and bars complying with ASTM A 36/A 36M. Bases shall have shape to accommodate supported equipment.
4. Support Brackets: Factory-welded steel angles on frame for outrigger isolation mountings and to provide for anchor bolts and equipment support.

5. Fabrication: Fabricate steel templates to hold equipment anchor-bolt sleeves and anchors in place during placement of concrete. Obtain anchor-bolt templates from supported equipment manufacturer.

D. **Type D** Curb Mounted Aluminum Bases:

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type CMAB or a comparable product by one of the following:
   
   a. Kinetics Noise Control, Inc.
   b. ThyCurb/Thybar.
   c. Vibro-Acoustics.
   d. Vib-Iso.

2. Description: Factory-assembled, fully enclosed, insulated, air- and watertight curb rail designed to resiliently support equipment.


4. Lower Frame: Corrosion resistant extruded aluminum. Lower framed shall overlap roof curb for water runoff. Mitered ends heliarc welded to prevent water leakage through corners.

5. Safety Stops: Neoprene, mounted in corners of lower frame for extreme wind conditions and mild seismic disturbances under normal conditions.

6. Isolators: Cadmium plated free-standing springs with positive spring retainer and flexible ties.

7. Splicing Kit: Required for bases shipped in multiple pieces.

8. Weatherseal: Flexible frictionless EPDM.

9. Static Deflection: Nominal 1 inch.

2.2 VIBRATION ISOLATORS

A. **Type 1a** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, arranged in single or multiple layers (maximum 3 layers separated by steel shims) to achieve 90 percent efficiency, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for
uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type W, Super W, WSW, and WSWSW or comparable products by one of the following:
   a. Amber/Booth; a VMC Group Company.
   b. Kinetics Noise Control, Inc.
   c. Korfund Dynamics; a VMC Group Company.
   d. Vibration Eliminator Co., Inc.
   e. Vibration Mountings & Controls; a VMC Group Company.
   f. Vibro-Acoustics.


B. **Type 1b** Elastomeric Isolator Pads: Oil- and water-resistant elastomer, single layer, molded with a nonslip pattern and galvanized steel baseplates of sufficient stiffness for uniform loading over pad area, and 1/4 inch steel load bearing plate. Factory cut to sizes that match requirements of supported equipment.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type Super WMSW and MBSW or a comparable product by one of the following:
   a. Amber/Booth; a VMC Group Company.
   b. Kinetics Noise Control, Inc.
   c. Korfund Dynamics; a VMC Group Company.
   d. Vibration Eliminator Co., Inc.
   e. Vibration Mountings & Controls; a VMC Group Company.
   f. Vibro-Acoustics.


C. **Type 2** Elastomeric Mounts: Double-deflection type, with molded, oil-resistant rubber or neoprene isolator elements with factory-drilled, encapsulated top plate for bolting
to equipment and with baseplate for bolting to structure. Color-code or otherwise identify to indicate capacity range.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type ND or a comparable product by one of the following:
   a. Amber/Booth; a VMC Group Company.
   b. Kinetics Noise Control, Inc.
   c. Korfund Dynamics; a VMC Group Company.
   d. Vibration Eliminator Co., Inc.
   e. Vibration Mountings & Controls; a VMC Group Company.
   f. Vibro-Acoustics.

2. Durometer Rating: Selected for maximum possible static deflection with the loading of each piece of equipment.

3. Materials: Cast-ductile-iron housing containing two separate and opposing, molded, bridge-bearing neoprene elements that prevent central threaded sleeve and attachment bolt from contacting the casting during normal operation.

4. Neoprene: Bridge-bearing neoprene as defined by AASHTO.

D. Type 3 Spring Isolators: Freestanding, open-spring isolators.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type SLF or a comparable product by one of the following:
   a. Amber/Booth; a VMC Group Company.
   b. Kinetics Noise Control, Inc.
   c. Korfund Dynamics; a VMC Group Company.
   d. Vibration Eliminator Co., Inc.
   e. Vibration Mountings & Controls; a VMC Group Company.
   f. Vibro-Acoustics.

2. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

5. Baseplates: Factory drilled for bolting to structure and bonded to 1/4-inch-thick, rubber isolator pad attached to baseplate underside. Baseplates shall limit floor load to 100 psig.

6. Top Plate and Adjustment Bolt: Threaded top plate with adjustment bolt and cap screw to fasten and level equipment.

E. **Type 4** Restraigned Spring Isolators: Restraigned single and multiple spring mounts.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Types SLR and SLRS or comparable products by one of the following:

   a. Amber/Booth; a VMC Group Company.
   b. Kinetics Noise Control, Inc.
   c. Korfund Dynamics; a VMC Group Company.
   d. Vibration Eliminator Co., Inc.
   e. Vibration Mountings & Controls; a VMC Group Company.
   f. Vibro-Acoustics.

2. Housing: Steel with resilient vertical-limit stops to prevent spring extension due to wind loads or if weight is removed; factory-drilled baseplate bonded to 1/4-inch-thick, elastomeric isolator pad attached to baseplate underside; and adjustable equipment mounting and leveling bolt that acts as blocking during installation.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

F. **Type 5** Thrust Restraints

1. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression or tension as required, and with a load stop. Include rod and angle-iron brackets with back-up plates for attaching to equipment and ductwork.
a. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type WBI for fan inlet connections, and Type WBD for fan outlet connections, or comparable products by one of the following:

1) Amber/Booth; a VMC Group Company.
2) Kinetics Noise Control, Inc.
3) Korfund Dynamics; a VMC Group Company.
4) Vibration Eliminator Co., Inc.
5) Vibration Mountings & Controls; a VMC Group Company.
6) Vibro-Acoustics.

b. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.

c. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

d. Minimum Additional Travel: 50 percent of the required deflection at rated load.

e. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.

f. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

g. Elastomeric Element: Molded, oil-resistant rubber or neoprene.

h. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.3 VIBRATION ISOLATION HANGERS

A. **Type 8a** Spring Hangers: Combination coil-spring and elastomeric-insert hanger with spring and insert in compression.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type 30N or a comparable product by one of the following:

a. Amber/Booth; a VMC Group Company.

b. Kinetics Noise Control, Inc.

c. Korfund Dynamics; a VMC Group Company.

d. Vibration Eliminator Co., Inc.
e. Vibration Mountings & Controls; a VMC Group Company.
f. Vibro-Acoustics.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.

5. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.

6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.

7. Elastomeric Element: Molded, oil-resistant rubber or neoprene. Steel-washer-reinforced cup to support spring and bushing projecting through bottom of frame.

B. **Type 8b** Spring Hangers with Vertical-Limit Stop: Precompressed combination coil-spring and elastomeric-insert hanger with spring and insert in compression and with a vertical-limit stop.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Mason Industries, Inc.; Type PC30N or a comparable product by one of the following:

a. Amber/Booth; a VMC Group Company.
b. Kinetics Noise Control, Inc.
c. Korfund Dynamics; a VMC Group Company.
d. Vibration Eliminator Co., Inc.
e. Vibration Mountings & Controls; a VMC Group Company.
f. Vibro-Acoustics.

2. Frame: Steel, fabricated for connection to threaded hanger rods and to allow for a maximum of 30 degrees of angular hanger-rod misalignment without binding or reducing isolation efficiency.

3. Outside Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.

4. Minimum Additional Travel: 50 percent of the required deflection at rated load.
5. Lateral Stiffness: More than 80 percent of the rated vertical stiffness.
6. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
7. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
8. Adjustable Vertical Stop: Steel washer with neoprene washer "up-stop" on lower threaded rod.

2.4 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested equipment before shipping.
   1. Powder coating on springs and housings.
   2. All hardware shall be electrogalvanized. Hot-dip galvanize metal components for exterior use.
   3. Baked enamel for metal components on isolators for interior use.
   4. Color-code or otherwise mark vibration isolation devices to indicate capacity range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and equipment to receive vibration isolation devices for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install roof curbs, equipment supports, and roof penetrations as specified in Division 07 Section "Roof Accessories."

B. Install thrust limits at centerline of thrust, symmetrical on either side of equipment.
3.3 APPLICATION

A. Refer to Vibration Isolator Application Schedule on the drawings for isolator application and minimum deflection.

3.4 CONNECTIONS

A. Provide flexible electrical connections in the form of large radius, 360 degree loop of flexible conduit for all vibrating isolated equipment. Any cooling water lines, compressed air, or other piping services (except inlet and outlet water connections for pumps, chillers or cooling tower) shall be made with 360 degree loops of reinforced neoprene hose, which are attached using nipples of appropriate gender. All service connections made with neoprene hose shall have shut-off valves between the hose and the supply service.

B. Vibration isolate piping connected to vibration isolated equipment using Type 8a or 8b spring hangers, and with distance to be isolated as scheduled on the Drawings. Maximum spacing between isolators same as maximum distance between pipe hangers and supports.

C. Vibration isolate ductwork connected to air handling units, return air fans, and vibration isolated equipment using Type 8a or 8b spring hangers, and in accordance with isolation distances scheduled on the Drawings.

3.5 EQUIPMENT BASES

A. Fill concrete inertia bases, after installing base frame, with 3000-psi concrete; trowel to a smooth finish.

1. Cast-in-place concrete materials and placement requirements are specified in Division 03.

B. Concrete Bases: Anchor equipment to concrete base according to supported equipment manufacturer's written instructions.

1. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
2. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base and anchor into structural concrete floor.
3. Place and secure anchorage devices. Use Setting Drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
4. Install anchor bolts to elevations required for proper attachment to supported equipment.
5. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
6. Cast-in-place concrete materials and placement requirements are specified in Division 03.

3.6 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:
   1. Isolator deflection.
   2. Snubber minimum clearances.

3.7 ADJUSTING

A. Adjust isolators after piping systems have been filled and equipment is at operating weight.
B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.
C. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop.
D. Adjust active height of spring isolators.
E. Adjust snubbers according to manufacturer's written recommendations.

3.8 CLEANING

A. After completing equipment installation, inspect vibration isolation devices. Remove paint splatters and other spots, dirt, and debris.
3.9 VIBRATION ISOLATOR SCHEDULE

A. Refer to drawings.

END OF SECTION 15070
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in Maintenance Manuals.

1.3 QUALITY ASSURANCE


1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:

1. Seton.
2. Brady.
3. EMED.
5. Brimar Industries, Inc.
2.2 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
   a. Manufacturer, product name, model number, and serial number.
   b. Capacity, operating and power characteristics, and essential data.
   c. Labels of tested compliances.

2. Location: Accessible and visible.
3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.
2. Data:
   a. Name and plan number.
   b. Equipment service.
   c. Design capacity.
   d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.
2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.
3. Thickness: Minimum 1/16 inch, unless otherwise indicated.
4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
D. Access Panel and Door Markers: 1/16-inch-thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

2.3 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME (ANSI) A13.1, unless otherwise indicated.
2. Type and Size of Letters: Comply with ANSI A13.1, unless otherwise indicated.
3. Legends: Spelled out in full or commonly used and accepted abbreviations.
4. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
5. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
6. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.


E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

F. Underground Pipe Markers: Bright colored continuously printed plastic ribbon tape of not less than 6 inches wide by 4mil thick, manufactured for direct burial service.

G. Detectable Underground Pipe Markers: Continuously printed plastic ribbon tape with detectable aluminum core and with colors meeting APWA requirements, not less than 6 inches wide by 4 mil thick, manufactured for direct burial service.

2.4 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

B. Duct Markers: Vinyl, 2-inch minimum character height, with permanent pressure sensitive adhesive. Include direction and quantity of airflow, air handling unit or fan number, and duct service (such as supply, return, and exhaust).

2.5 HAZARDOUS MATERIAL IDENTIFICATION DEVICES

A. Standard: NFPA 704.

B. Material: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive; or mounting screws.

C. Size: Minimum 7-1/2 inches by 7-1/2 inches with 3-inch character height.

D. Content: Appropriate for refrigerant or other hazardous material.

2.6 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with
numbering scheme to match Owner’s existing numbering scheme. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch-thick brass.
2. Valve-Tag Fasteners: Brass wire-link chain or beaded chain.

2.7 VALVE SCHEDULES

A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.

1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Finished hardwood or extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.8 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.
3.2 EQUIPMENT IDENTIFICATION

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units, including boilers, heaters, and water heaters.
2. Pumps, condensers, and similar motor-driven units.
3. Fans, blowers, primary balancing dampers, and terminal units.
4. Packaged HVAC rooftop units.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:

   a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
   b. Fire department hose valves and hose stations.
   c. Meters, gages, thermometers, and similar units.
   d. Fuel-burning units, including boilers, heaters, and water heaters.
   e. Pumps, condensers, and similar motor-driven units.
   f. Fans, blowers, primary balancing dampers, and terminal units.
   g. Packaged HVAC rooftop units.
h. Strainers, filters, water-treatment systems, and similar equipment.

C. Install access panel markers with screws on equipment access panels.

D. Area Served: Equipment serving different areas of a building other than where the equipment is installed shall be permanently marked in a manner that, in addition to identifying the equipment as specified in this Section, also identifies the area it serves.

3.3 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, minimum 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.

C. Underground Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

3.4 DUCT IDENTIFICATION

A. Install engraved duct markers with permanent adhesive on air ducts in the following color codes:

1. Refer to Schedule.
2. ASME (ANSI) A13.1 Colors and Designs: For hazardous material exhaust.
3. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

B. Identify ductwork with vinyl markers and flow direction arrows.

C. Locate markers at air handling units, each side of floor and wall penetrations, near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

1. Valve-Tag Size and Shape:
   a. Cold Water: Minimum 1-1/2 inches, round or square.
   b. Hot Water: Minimum 1-1/2 inches, round or square.
   c. Fire Protection: Minimum 1-1/2 inches, round or square.
   d. Gas: Minimum 1-1/2 inches, round or square.

3.6 VALVE-SCHEDULE INSTALLATION
A. Mount valve schedule on wall in accessible location in each major equipment room.

3.7 HAZARDOUS MATERIAL IDENTIFICATION DEVICES
A. Mount to wall or door of room containing hazard. Indicate classification of refrigerant or other hazard.

3.8 WARNING-TAG INSTALLATION
A. Write required message on, and attach warning tags to, equipment and other items where required.

3.9 ADJUSTING
A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.10 CLEANING
A. Clean faces of mechanical identification devices and glass frames of valve schedules.

3.11 SCHEDULES
A. Paint colors are listed here for reference only. Painting is specified under Division 9.
PIPE LABELING AND COLOR CODING

<table>
<thead>
<tr>
<th>Pipe System Label</th>
<th>Drawing Abbreviation</th>
<th>Labels</th>
<th>Piping</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanitary Sewer</td>
<td>SAN</td>
<td>White on Green</td>
<td>Dark Brown</td>
</tr>
<tr>
<td>Sanitary Vent</td>
<td>V</td>
<td>White on Green</td>
<td>Dark Brown</td>
</tr>
<tr>
<td>Rain Conductor</td>
<td>RC</td>
<td>White on Green</td>
<td>Dark Brown</td>
</tr>
<tr>
<td>Domestic Cold Water</td>
<td>CW</td>
<td>White on Green</td>
<td>Light Green</td>
</tr>
<tr>
<td>Non-Potable Cold Water</td>
<td>NPCW</td>
<td>Black on Yellow</td>
<td></td>
</tr>
<tr>
<td>Domestic Hot Water</td>
<td>HW</td>
<td>Black on Yellow</td>
<td>Dark Green</td>
</tr>
<tr>
<td>Domestic Hot Water Return</td>
<td>HWR</td>
<td>Black on Yellow</td>
<td>Dark Green</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>G</td>
<td>Black on Yellow</td>
<td>Yellow</td>
</tr>
<tr>
<td>Hot Water Htg. Supply</td>
<td>HWHS</td>
<td>Black on Yellow</td>
<td>Dark Blue</td>
</tr>
<tr>
<td>Hot Water Htg. Return</td>
<td>HWHR</td>
<td>Black on Yellow</td>
<td>Dark Blue</td>
</tr>
<tr>
<td>Refrigerant Liquid</td>
<td>RL</td>
<td>Black on Yellow</td>
<td></td>
</tr>
<tr>
<td>Refrigerant Suction</td>
<td>RS</td>
<td>Black on Yellow</td>
<td></td>
</tr>
<tr>
<td>Fire Protection</td>
<td>FP</td>
<td>White on Red</td>
<td>Bright Red</td>
</tr>
</tbody>
</table>

SHEET METAL WORK

<table>
<thead>
<tr>
<th>Service</th>
<th>Abbreviation</th>
<th>Labels</th>
<th>Ductwork</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Conditioning Supply</td>
<td>Supply Air</td>
<td>White on Green</td>
<td>White</td>
</tr>
<tr>
<td>Air Conditioning Supply Return</td>
<td>Return Air</td>
<td>White on Green</td>
<td>White</td>
</tr>
<tr>
<td>Exhaust Systems</td>
<td>Exhaust Air</td>
<td>Black on Yellow</td>
<td>Green</td>
</tr>
</tbody>
</table>

END OF SECTION 15075
SECTION 15080 - MECHANICAL INSULATION

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3.9 FIELD-APPLIED JACKET INSTALLATION
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:
   1. Division 15 Section “Mechanical General Requirements.”
   2. Division 15 Section “Basic Materials and Methods.”
   3. Division 15 Section “Hanger and Supports” for thermal hanger shield inserts.
   4. Division 15 Section “Plumbing Fixtures: for protective shielding guards.
   5. Division 15 Section ”Metal Ducts" for duct liners.

1.2 SUMMARY

A. This Section includes mechanical insulation for pipe, duct, and equipment.

1.3 DEFINITIONS

A. ASJ: All-service jacket.

B. FSK: Foil, scrim, kraft paper.

C. PVC: Polyvinyl Chloride.

D. SSL: Self-sealing lap.

1.4 INDOOR PIPING INSULATION SYSTEMS DESCRIPTION

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are scheduled on the Drawings, or identified for each piping system and pipe size range.

B. Storm Water and Overflow:
   1. Horizontal pipe and fittings; and first vertical connection to roof or area sump plus the next 7 feet of vertical pipe and fittings.
   2. All Pipe Sizes: Insulation shall be either of the following:
a. Flexible Elastomeric: 1 inch thick.
b. Glass-Fiber Pipe Insulation, Type I: 1 inch (25 mm) thick.

C. Roof Drain and Overflow Drain Bodies:

1. All Pipe Sizes: Insulation shall be either of the following:
   a. Flexible Elastomeric: 1 inch thick.
   b. Glass-Fiber Pipe Insulation, Type I: 1 inch (25 mm) thick.

D. Condensate and Equipment Drain Water below 60 Deg F (16 Deg C):

1. All Pipe Sizes: Insulation shall be either of the following:
   a. Flexible Elastomeric: 3/4 inch thick.
   b. Glass-Fiber Pipe Insulation, Type I: 1 inch (25 mm) thick.

E. Heating-Hot-Water Supply and Return, 200 Deg F (93 Deg C) and below:

1. NPS 3 and Smaller: Glass-Fiber, Preformed Pipe Insulation, Type I.
2. NPS 4 (DN 100) and Larger: Glass-Fiber, Preformed Pipe Insulation, Type I.

F. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be any of the following:
   a. Flexible Elastomeric: 1 inch (25 mm) thick.
   b. Glass-Fiber Pipe Insulation, Type I: 1 inch (25 mm) thick.

G. Refrigerant Suction and Hot-Gas Flexible Tubing, All Pipe Sizes: Flexible Elastomeric: 1 inch (25 mm) thick.

1.5 DUCT INSULATION SYSTEMS DESCRIPTION, GENERAL

A. Plenums and Ducts Requiring Insulation:
1. Indoor supply, including around duct mounted coils and air terminal unit coil sections.
2. Indoor return located in unconditioned space.
3. Indoor return located in Mechanical Equipment Rooms.
4. Indoor exhaust and relief air between isolation damper and penetration of building exterior.

B. Plenums, Ducts and Duct Accessories Not Insulated:

1. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
2. Factory-insulated flexible ducts.
3. Factory-insulated plenums and casings.
4. Flexible connectors.
5. Vibration-control devices.
6. Factory-insulated access panels and doors.
7. Indoor return in conditioned spaces.

1.6 INDOOR DUCT AND PLENUM INSULATION SYSTEMS DESCRIPTION

A. Acceptable indoor duct and plenum insulation materials and thicknesses are scheduled on the Drawings.

1.7 EQUIPMENT INSULATION SYSTEMS DESCRIPTION

A. Acceptable equipment insulation materials and thicknesses are scheduled on the Drawings.

1.8 FIELD-APPLIED JACKETING SYSTEMS DESCRIPTION

A. Acceptable field-applied jacketing materials and thicknesses are scheduled on the Drawings.

1.9 SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and jackets (both factory and field applied, if any).

1. ESR Report: For fire-rated grease duct insulation.

B. Shop Drawings: Show details for the following:

1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Attachment and covering of heat tracing inside insulation.
3. Insulation application at pipe expansion joints for each type of insulation.
4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Removable insulation at piping specialties, equipment connections, and access panels.
6. Application of field-applied jackets.
7. Application at linkages of control devices.
8. Field application for each equipment type
9. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

1.10 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, and cement material containers, with appropriate markings of applicable testing and inspecting agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

B. Ductwork Insulation Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.11 DELIVERY, STORAGE, AND HANDLING

A. Prior to installation, protect insulation from exposure to water and from physical damage. Prior to installation, store insulation in manufacturer’s original packaging.

1.12 COORDINATION

A. Coordinate size and location of supports, hangers, and pre-insulated pipe shields/supports specified in Division 15 Section "Hangers and Supports."
B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.13 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS, GENERAL REQUIREMENTS

A. Products shall not contain asbestos, lead, mercury, or mercury compounds.

B. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Adhesives used shall be fire resistant in their dry states and UL listed.

2.2 PIPE INSULATION MATERIALS

A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.
1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Armacell LLC; AP Armaflex.
   b. IK Insulation Group; K-Flex USA LLC; Insul-Tube and Insul-Sheet.

B. Glass-Fiber, Preformed Pipe Insulation, Type I:

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Johns Manville; Micro-Lok.
   b. Knauf Insulation; 1000 Pipe Insulation.
   c. Manson Insulation Inc.; Alley-K.
   d. Owens Corning; Fiberglas Pipe Insulation.

2. Type I, 850 deg F Materials: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

C. Mineral-Wool, Preformed Pipe Insulation, Type II:

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Fibrex Insulations Inc.; Coreplus 1200.
   b. Rock Wool Manufacturing Company; Delta PC and PF.
   c. Roxul Inc.; 1200 Pipe Insulation.

2. Type II, 1200 deg F Materials: Mineral wool fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type II, Grade A, with factory-applied ASJ or ASJ-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.3 DUCTWORK INSULATION MATERIALS

A. Blanket Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. CertainTeed Corp.; Duct Wrap.
   b. Johns Manville; Microlite EQ.
   c. Knauf Insulation; Duct Wrap.
   d. Manson Insulation Inc.; Alley Wrap FSK.
   e. Owens Corning; All-Service Duct Wrap.

B. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. CertainTeed Corp.; Commercial Board.
   b. Fibrex Insulations Inc.; FBX.
   c. Johns Manville; 800 Series Spin-Glas.
   d. Knauf Insulation; Insulation Board.
   e. Manson Insulation Inc.; AK Board.
   f. Owens Corning; Fiberglas 700 Series.

C. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Armacell LLC; AP Armaflex.
   b. IK Insulation Group; K-Flex USA LLC; Insul-Sheet.

2.4 EQUIPMENT INSULATION MATERIALS

A. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type II for sheet materials.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Armacell LLC; AP Armaflex.
b. IK Insulation Group; K-Flex USA LLC; Insul-Sheet and Insul-Tube.

B. Board Insulation: Glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For equipment applications, provide insulation with factory-applied ASJ. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   - a. CertainTeed Corp.; Commercial Board.
   - b. Fibrex Insulations Inc.; FBX.
   - c. Johns Manville; 800 Series Spin-Glas.
   - d. Knauf Insulation; Insulation Board.
   - e. Manson Insulation Inc.; AK Board.
   - f. Owens Corning; Fiberglas 700 Series.

C. Large Diameter Pipe and Tank Insulation: Glass fibers bonded with a thermosetting resin. Semirigid board material with factory-applied ASJ complying with ASTM C 1393, Type II or Type IIIA Category 2, or with properties similar to ASTM C 612, Type IB. Nominal density is 2.5 lb/cu. ft. or more. Thermal conductivity (k-value) at 100 deg F is 0.29 Btu x in./h x sq. ft. x deg F or less. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   - a. CertainTeed Corp.; CrimpWrap.
   - b. Johns Manville; MicroFlex.
   - c. Knauf Insulation; Pipe and Tank Insulation.
   - d. Manson Insulation Inc.; AK Flex.
   - e. Owens Corning; Fiberglas Pipe and Tank Insulation.

2.5 INSULATING CEMENTS


1. Products: Subject to compliance with requirements, provide one of the products specified.
   - a. Insulco, Division of MFS, Inc.; Triple I.
B. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449/C 449M.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Insulco, Division of MFS, Inc.; SmoothKote.
   c. Rock Wool Manufacturing Company; Delta One Shot.

2.6 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to it and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Armacell LLC; 520 Adhesive.
   b. Foster Products Corporation, H. B. Fuller Company; 85-75.
   c. RBX Corporation; Rubatex Contact Adhesive.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Childers Products, H.B. Fuller Company; CP-82.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.
   f. Vimasco Corporation.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Childers Products, H.B. Fuller Company; CP-82.
   c. ITW TACC, Division of Illinois Tool Works; S-90/80.
   d. Marathon Industries, Inc.; 225.
   e. Mon-Eco Industries, Inc.; 22-25.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Dow Chemical Company (The); 739, Dow Silicone.
   e. Speedline Corporation; Speedline Vinyl Adhesive.

2.7 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   b. Foster Products Corporation, H. B. Fuller Company; 30-90.
   c. ITW TACC, Division of Illinois Tool Works; CB-50.
   d. Marathon Industries, Inc.; 590.
   e. Mon-Eco Industries, Inc.; 55-40.
   f. Vimasco Corporation; 749.

2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.


C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   b. Foster Products Corporation, H. B. Fuller Company; 35-00.
   c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
   e. Mon-Eco Industries, Inc.; 55-50.
   f. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.

3. Service Temperature Range: Minus 20 to plus 200 deg F.

4. Solids Content: 63 percent by volume and 73 percent by weight.


2.8 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   b. Foster Products Corporation, H. B. Fuller Company; 81-42.
   c. Marathon Industries, Inc.; 130.
   d. Mon-Eco Industries, Inc.; 11-30.
   e. Vimasco Corporation; 136.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.

3. Service Temperature Range: Minus 50 to plus 180 deg F.

2.9 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.
   b. Foster Products Corporation, H. B. Fuller Company; 95-44.
   c. Marathon Industries, Inc.; 405.
   d. Mon-Eco Industries, Inc.; 44-05.
   e. Vimasco Corporation; 750.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.

5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Childers Products, H.B. Fuller Company; CP-76.

2. Materials shall be compatible with insulation materials, jackets, and substrates.

3. Fire- and water-resistant, flexible, elastomeric sealant.

4. Service Temperature Range: Minus 40 to plus 250 deg F.


2.10 FACTORY-APPLIED JACKETS

A. Insulation systems indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.

3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.11 FIELD-APPLIED FABRIC-REINFORCING MESH

A. Woven Glass-Fiber Fabric for Pipe Insulation: Approximately 2 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch for covering pipe and pipe fittings.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Vimasco Corporation; Elastafab 894.
   b. Or approved equal.


1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Childers Products, H.B. Fuller Company; Chil-Glas No. 5.
   b. Or approved equal.

C. Woven Polyester Fabric: Approximately 1 oz./sq. yd. with a thread count of 10 strands by 10 strands/sq. inch, in a Leno weave, for duct, equipment, and pipe.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   b. Vimasco Corporation; Elastafab 894.
2.12 FIELD-APPLIED CLOTHS

A. Woven Glass-Fiber Fabric: Comply with MIL-C-20079H, Type I, plain weave, and presized a minimum of 8 oz./sq. yd..

1. Products: Subject to compliance with requirements, provide one of the products specified.
   b. Lewco Products.
   c. Mid-Mountain.
   d. TCI.

2.13 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as specified; roll stock ready for shop or field cutting and forming.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Johns Manville; Zeston and Ceel-Co.
   c. Proto PVC Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
4. Factory-fabricated tank heads and tank side panels.

C. PVC Fitting Covers: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C, and including flexible glass fiber insulation inserts.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Johns Manville; Zeston and Ceel-Co.
c. Proto PVC Corporation; LoSmoke.
   d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by manufacturer.


4. Factory-fabricated fitting covers:
   a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.

D. Metal Jacket:

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. PABCO-Childers Metals; ITW Insulation Systems; Metal Jacketing Systems.
   b. RPR Products, Inc.; Insul-Mate.

   a. Sheet and roll stock ready for shop or field sizing or factory cut and rolled to size.
   b. Finish and thickness are indicated in field-applied jacket schedules.
   d. Moisture Barrier for Outdoor Applications: 3-mil-thick, heat-bonded polyethylene and kraft paper or 2.5-mil-thick Polysurlyn.
   e. Factory-Fabricated Fitting Covers:
      1) Preformed 2-piece or gore, 45- and 90-degree, short- and long-radius elbows.
      2) Provide factory fabricated PVC tee covers, flange and union covers, beveled collars and valve covers.
      3) Field fabricate fitting covers only if factory-fabricated fitting covers are not available.
2.14 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
   b. Compac Corp.; 104 and 105.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
   d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136 and UL listed.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
   b. Compac Corp.; 110 and 111.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
   d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.
C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
   b. Compac Corp.; 130.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
   d. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive and UL listed.

1. Products: Subject to compliance with requirements, provide one of the products specified.
   a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
   b. Compac Corp.; 120.
   c. Ideal Tape Co., Inc., an American Biltrite Company; 488 AWF.
   d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

2.15 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the products specified.
a. PABCO-Childers Metals; ITW Insulation Systems; Pab-Bands and Fabstraps.

b. RPR Products, Inc.; Bands.

2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 1/2 inch wide with wing or closed seal.

3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.


B. Insulation Pins and Hangers:

1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

   a. Products: Subject to compliance with requirements, provide one of the products specified.

      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; CD.
      3) Midwest Fasteners, Inc.; CD.
      4) Nelson Stud Welding; TPA, TPC, and TPS.

2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch- diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.

   a. Products: Subject to compliance with requirements, provide one of the products specified.

      1) AGM Industries, Inc.; CWP-1.
      2) GEMCO; Cupped Head Weld Pin.
      3) Midwest Fasteners, Inc.; Cupped Head.
      4) Nelson Stud Welding; CHP.
3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, provide one of the products specified.

      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.

   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

   c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, provide one of the products specified.

      1) GEMCO; Nylon Hangers.
      2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.

   b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.

   c. Spindle: Nylon, 0.106-inch- diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.

5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:

   a. Products: Subject to compliance with requirements, provide one of the products specified.

      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
      2) GEMCO; Press and Peel.
      3) Midwest Fasteners, Inc.; Self Stick.

   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.

   c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch- diameter shank, length to suit depth of insulation indicated.

   d. Adhesive-backed base with a peel-off protective cover.

6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch- thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

   a. Products: Subject to compliance with requirements, provide one of the products specified.

      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.
      4) Nelson Stud Welding; Speed Clips.

   b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.
7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Manufacturers:
      1) GEMCO.
      2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.
   1. Manufacturers:
      a. ACS Industries, Inc.
      b. C & F Wire.
      c. PABCO-Childers Metals; ITW Insulation Systems.
      d. RPR Products, Inc.

2.16 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.

B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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.

3.3 COMMON INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and 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. Install insulation with longitudinal seams at the 4 o’clock or 8 o’clock position on horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.
H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive as recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. For services with surface temperatures below ambient, install a continuous unbroken vapor barrier. 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 thermal hanger 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 thermal hanger 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.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. 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 the 4 o’clock or 8 o’clock position on the pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 4 inches o.c.
a. For below ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.

5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness. Where compression of insulation is possible, fabricate/install insulation per manufacturer’s recommendations.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. 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.

P. 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.
5. Handholes.
6. Cleanouts.

3.4 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 Below-Grade 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:
   1. Terminate ductwork insulation at angle closure of fire damper sleeves.
   2. Install pipe insulation continuously through penetrations of fire-rated walls and partitions.
      a. Firestopping is specified in Division 07 Section “Through-Penetration Firestop Systems.”

F. Insulation Installation at Floor Penetrations:
   1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at angle closure of fire damper sleeves.
   2. Pipe: Install insulation continuously through floor penetrations.
a. Seal penetrations through fire-rated assemblies according to Division 07 Section "Through-Penetration Firestop Systems."

3.5 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, 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, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.

2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union 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.

E. Install removable and reusable insulation covers in accordance with fabricator’s instructions, and at the following locations:

1. At valves, flanges, and expansion joints. Expansion joints shall have jacket installed in a manner to allow for replacing of joints without removing insulation cover.

3.6 FLEXIBLE ELASTOMERIC PIPE INSULATION INSTALLATION

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 GLASS-FIBER AND MINERAL WOOL PIPE INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe 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 surfaces, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but 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 PVC fitting covers when available.
2. When PVC fitting covers are not available, install preformed pipe insulation to outer diameter of pipe flange:
   a. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   b. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with fiberglass or mineral wool blanket insulation as specified for system.
3. 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 PVC fitting covers when available.
2. When PVC fitting covers are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install PVC fitting covers when available.
2. When PVC fitting covers are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 DUCT AND PLENUM INSULATION INSTALLATION

A. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions. Adhesive may be omitted from top surface of horizontal rectangular ducts.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
   b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
   c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
   d. Do not over compress insulation during installation.
   e. Impale insulation over pins and attach speed washers.
   f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
   a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.

6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

B. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.

1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.

2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.

3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:

   a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.

   b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
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c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
d. Do not over compress insulation during installation.
e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.

4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.

a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.

6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

C. Flexible Elastomeric Thermal Insulation Installation for Ducts and Plenums: Install insulation over entire surface of ducts and plenums.
1. Apply 100 percent coverage of adhesive to surface with manufacturer's recommended adhesive.
2. Seal longitudinal seams and end joints.
3. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with strips of same material used to insulate duct and following manufacturer’s installation instructions.

3.9 FIELD-APPLIED JACKET INSTALLATION

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inch overlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. 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.

E. Where self-adhesive jackets are indicated, install according to manufacturer’s instructions and details on the drawings. Overlap seams arranged to shed water.
F. Where sound barrier jackets are indicated, install in accordance with manufacturer’s instructions.

3.10 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system specified in Division 09 painting Sections.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

END OF SECTION 15080
SECTION 15110 - GENERAL DUTY VALVES FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

1.3 DEFINITIONS

1.4 SUBMITTALS

1.5 QUALITY ASSURANCE

1.6 DELIVERY, STORAGE, AND HANDLING

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

2.2 BRONZE BALL VALVES

2.3 GENERAL SERVICE BUTTERFLY VALVES

2.4 BRONZE CHECK VALVES

2.5 IRON SWING CHECK VALVES

2.6 LIFT CHECK VALVES

2.7 SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES

2.8 BRONZE GLOBE VALVES

2.9 DRAIN VALVES

2.10 CHAINWHEEL ACTUATORS

2.11 SOURCE QUALITY CONTROL

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 VALVE APPLICATIONS

3.3 VALVE INSTALLATION

3.4 JOINT CONSTRUCTION

3.5 ADJUSTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 02 piping sections for general-duty and specialty valves for site construction piping.
2. Divisions 13 and 15 fire-suppression piping sections for fire-protection valves.
3. Division 15 Section "Mechanical Identification" for valve tags and charts.
4. Division 15 piping sections for specialty valves applicable to those Sections only.
5. Division 15 Section “General-Duty Valves for HVAC” for HVAC valves.
6. Division 15 Section "Temperature Controls" for control valves and actuators.
7. Division 33 piping sections for general-duty and specialty valves for site construction piping.

1.2 SUMMARY

A. This Section includes valves for general plumbing applications. Refer to piping Sections for specialty valve applications.

1.3 DEFINITIONS

A. The following are standard abbreviations for valves:

1. CWP: Cold working pressure.
2. EPDM: Ethylene-propylene-diene terpolymer rubber.
3. NBR: Acrylonitrile-butadiene rubber.
4. NRS: Nonrising stem.
5. OS&Y: Outside screw and yoke.
6. PTFE: Polytetrafluoroethylene plastic.
7. RPTFE: Reinforced polytetrafluoroethylene plastic.
8. SWP: Steam working pressure.
9. TFE: Tetrafluoroethylene plastic.
10. WOG: Water, oil, and gas.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1. Certification that products for use in potable water systems comply with NSF 61 and NSF 372.
1.5 QUALITY ASSURANCE

A. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. NSF Compliance: NSF 61 and NSF 372 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

A. Isolation valves are scheduled on the Drawings. For other general plumbing valve applications, use the following:

1. Throttling Service: Angle, ball, butterfly, or globe valves.
2. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

D. For valves not indicated in the Application Schedules, select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded ends for heating hot water services.
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.
3. For Copper Tubing, NPS 5 and Larger: Flanged ends.
4. For Steel Piping, NPS 2 and Smaller: Threaded ends.
5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.
6. For Steel Piping, NPS 5 and Larger: Flanged ends.
7. For Grooved-End Systems: Valve ends may be grooved.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted unless otherwise noted.

F. Wetted surfaces of valves contacted by consumable water shall contain not more than 0.25 percent weighted average lead content.

1. Exceptions:

   a. Valves in pumped sanitary systems.
   b. Valves in pumped storm systems.
   c. Drain valves.
   d. Valves in general air or vacuum systems.
   e. Valves in irrigation systems.
   f. Valves in non-potable water systems.
   g. Valves in other plumbing systems not intended for human consumption.

G. Valve Sizes: Same as upstream pipe, unless otherwise indicated.
H. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.
2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.
3. Handwheel: For valves other than quarter-turn types.
4. Lever Handle: For quarter-turn valves NPS 6 and smaller.

I. Extended Valve Stems: On insulated valves.


K. Valve Grooved Ends: AWWA C606.

L. Solder Joint: With sockets according to ASME B16.18.

1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.

M. Threaded: With threads according to ASME B1.20.1.

N. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.

B. Two-Piece, Regular Port Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; and 150 psig SWP and 600-psig CWP ratings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Valves; by Conbraco Industries, Inc.; Series 70LF-140/240.
b. Hammond Valve.
c. Milwaukee Valve Company; Model UPBA100S/150S.
d. NIBCO INC.; Models S-580-70-66-LF/T-580-70-66-LF.
e. Watts Water Technologies, Inc.

C. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; 150 psig SWP and 600-psig CWP ratings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.; Series 77CLF-A Series.
   b. Hammond Valve.
   c. Milwaukee Valve Company; UPBA400S/450S.
   d. NIBCO INC.; Models S-585-70-66-LF/T-585-70-66-LF.

2.3 GENERAL SERVICE BUTTERFLY VALVES

A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:

1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.
2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.


1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD145.
b. Bray International, Inc.
c. DeZurik.
d. Forum Energy Technologies; ABZ Valve.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO INC.; LD-2000-3/5.
h. Pentair Valves & Controls; Keystone.
i. Tyco Flow Control; Grinnell Flow Control.
j. Watts Water Technologies.

C. Lug-Style (Single-Flange) Size NPS 14 and Larger, 150-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, one- or two-piece Type 416 stainless-steel stem, bronze bushing, and phenolic-backed EPDM seat (liner) attached to the body.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD145.
b. Bray International, Inc.
c. DeZurik.
d. Forum Energy Technologies; ABZ Valve.
e. Milwaukee Valve Company.
f. NIBCO INC.; LD-1000-5.
g. Pentair Valves & Controls; Keystone.
h. Tyco Flow Control; Grinnell Flow Control.
i. Watts Water Technologies.

2.4 BRONZE CHECK VALVES

A. Bronze Check Valves, General: MSS SP-80.

B. Class 125, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze disc, Y-pattern design, soldered or threaded end connections, and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
b. Milwaukee Valve Company; Model UP509/UP1509.
c. NIBCO INC.; Models S-413-B-LF or T-413-B-LF.
d. Watts Water Technologies; LFCVY/LFCVYS.

2.5 IRON SWING CHECK VALVES


B. Class 125, Gray-Iron, Standard Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; bronze disc and seat; and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Valves; by Conbraco Industries, Inc.; Model 910F.
   b. Crane Co.; Crane Valves.
   c. Crane Co.; Stockham Div.
   d. Hammond Valve; IR1124-HI.
   e. Milwaukee Valve Company; Model F-2974.
   f. NIBCO INC.; Model F-918-B.
   g. Watts Water Technologies.

C. Class 250, Gray-Iron, Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; and bronze disc and seat; and having 500 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Valves; by Conbraco Industries, Inc.; Model 920F.
   b. Crane Co.; Crane Valves.
   c. Crane Co.; Stockham Div.
   d. Hammond Valve; IR322.
   e. Milwaukee Valve Company; Model F-2970.
   f. NIBCO INC.; Model F-968-B.
   g. Watts Water Technologies.
D. Grooved-End, Swing Check Valves: Ductile-iron body with grooved or shouldered ends; nonasbestos, synthetic-fiber gaskets; rubber seats; and having 250-psig CWP Rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Mueller Co.
   b. NIBCO, INC.; Model G-917-W.
   c. Tyco Fire & Building Products; Grinnell Mechanical Products.
   d. Victaulic Co. of America.

2.6 LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic TFE Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Valves; by Conbraco Industries, Inc.; Model CBV-LF (61LF Series).
   b. Hammond Valve; UP943 and UP947.
   c. Milwaukee Valve Company; UP548T and UP1548T.
   d. NIBCO INC.; Model S-480-Y-LF and T-480-Y-LF.
   e. Watts Water Technologies; LF600.

2. Description:
   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 250 psig.
   d. Body Material: Lead free brass or bronze.
   e. Ends: Threaded or Solder.
   f. Disc: PTFE, or TFE.

2.7 SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES

A. Lift-Disc Check Valves, General: FCI 74-1 and MIL-V-18436F, with spring-loaded, center-guided bronze disc and seat.
B. Class 125, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. NIBCO INC.; Model W-910-B-LF.
   b. Mueller Steam Specialty.
   c. Milwaukee Valve Company.
   d. Hammond Valve.

C. Class 125, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends, and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. NIBCO INC.; Model F-910-B-LF.
   b. Mueller Steam Specialty.
   c. Milwaukee Valve Company.
   d. Hammond Valve.

2.8 BRONZE GLOBE VALVES

A. Bronze Globe Valves, General: MSS SP-80, with malleable-iron handwheel.

B. Class 125, TFE Disc, Bronze Globe Valves: ASTM B-62 bronze body, bonnet, and seat, TFE disc, copper-silicone bronze stem, union-ring bonnet, soldered or threaded end connections; and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Valves; by Conbraco Industries, Inc.; Model 121T-LF.
   b. Hammond Valve; UP418 and UP440.
   c. Milwaukee Valve Company; Model UP502 and UP1502.
   d. Watts Water Technologies, Inc.; LFGLV.
2.9 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves

1. Bronze ball valve as specified in this Section. Lead free construction is not required.
2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 CHAINWHEEL ACTUATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Babbitt Steam Specialty Co.
2. Roto Hammer Industries, Inc.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.

1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.
2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

2.11 SOURCE QUALITY CONTROL

A. Identification: Factory label or color coding to identify lead free valves.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.
C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Refer to Drawings.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.

E. Install valves in position to allow full stem movement.

F. Install chainwheel operators on valves NPS 4 and larger and more than 84 inches above floor. Extend chains to 60 inches above finished floor elevation.

G. Install check valves for proper direction of flow and as follows:
1. Swing Check Valves: In horizontal position with hinge pin level.
2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

3.4 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.5 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 15110
SECTION 15112 – GENERAL-DUTY VALVES FOR HVAC

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 13 and 15 fire-suppression piping and fire pump Sections for fire-protection valves.
2. Division 15 Section "Mechanical Identification" for valve tags and charts.
3. Division 15 Section “General-Duty Valves for Plumbing” for plumbing valves.
4. Division 15 Section "Temperature Controls" for control valves and actuators.

1.2 SUMMARY
A. This section includes valves for general HVAC applications. Refer to piping Sections for specialty valve applications.

1.3 DEFINITIONS
A. The following are standard abbreviations for valves:
   1. CWP: Cold working pressure.
   2. EPDM: Ethylene-propylene-diene terpolymer rubber.
   3. NBR: Acrylonitrile-butadiene rubber.
   4. NRS: Nonrising stem.
   5. OS&Y: Outside screw and yoke.
   6. PTFE: Polytetrafluoroethylene plastic.
   7. RPTFE: Reinforced polytetrafluoroethylene plastic.
   8. SWP: Steam working pressure.
   9. TFE: Tetrafluoroethylene plastic.
  10. WOG: Water, oil, and gas.

1.4 SUBMITTALS
A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.5 QUALITY ASSURANCE
A. ASME Compliance: ASME B31.9 for building services piping valves.
B. ASME Compliance for Ferrous Valves: ASME B16.10 and ASME B16.34 for dimension and design criteria.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Prepare valves for shipping as follows:
1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, gate, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 VALVES, GENERAL

A. Isolation valves are scheduled on the Drawings. For other general HVAC valve applications, use the following:

1. Throttling Service: Angle, ball, butterfly, or globe valves.
2. Pump Discharge: Spring-loaded, lift-disc check valves; and bronze lift check valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP class or CWP ratings may be substituted.

D. For valves not indicated in the Application Schedules, select valves with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Solder-joint or threaded ends, except provide valves with threaded
ends for condenser water, heating hot water, steam, and steam condensate services.

2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged, solder-joint, or threaded ends.

3. For Copper Tubing, NPS 5 and Larger: Flanged ends.

4. For Steel Piping, NPS 2 and Smaller: Threaded ends.

5. For Steel Piping, NPS 2-1/2 to NPS 4: Flanged ends.

6. For Steel Piping, NPS 5 and Larger: Flanged ends.

7. For Grooved-End Systems: Valve ends may be grooved. Do not use for steam or steam condensate piping.

E. Bronze valves shall be made with dezincification-resistant materials. Bronze valves made with copper alloy (brass) containing more than 15 percent zinc are not permitted.

F. Valve Sizes: Same as upstream pipe, unless otherwise indicated.

G. Valve Actuators:

1. Chainwheel: For attachment to valves, of size and mounting height, as indicated in the "Valve Installation" Article in Part 3.

2. Gear Drive Operator: For quarter-turn valves NPS 8 and larger.

3. Handwheel: For valves other than quarter-turn types.

4. Lever Handle: For quarter-turn valves NPS 6 and smaller.

H. Extended Valve Stems: On insulated valves.


J. Valve Grooved Ends: AWWA C606.

K. Solder Joint: With sockets according to ASME B16.18.

1. Caution: Disassemble valves when soldering, as recommended by the manufacturer, to prevent damage to internal parts.

L. Threaded: With threads according to ASME B1.20.1.

M. Valve Bypass and Drain Connections: MSS SP-45.
2.2 BRONZE BALL VALVES

A. Bronze Ball Valves, General: MSS SP-110 and have bronze body complying with ASTM B 584, except for Class 250 which shall comply with ASTM B 61, full-depth ASME B1.20.1 threaded or solder ends, and blowout-proof stems.

B. Two-Piece, Regular Port Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; and 150 psig SWP and 600-psig CWP ratings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Valves; by Conbraco Industries, Inc.; Series 70-140.
   b. Crane Co.; Crane Valves.
   c. Hammond Valve.
   d. Milwaukee Valve Company; Model BA100S.
   e. NIBCO INC.; Models S-580-70-66 or T-580-70-66.
   f. Watts Water Technologies, Inc.

C. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim: Type 316 stainless-steel ball and stem, reinforced TFE seats, blow-out-proof stem, with adjustable stem packing, soldered or threaded ends; 150 psig SWP and 600-psig CWP ratings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Valves; by Conbraco Industries, Inc.; Series 77C-A Series.
   b. Crane Co.; Crane Valves.
   c. Hammond Valve.
   d. Milwaukee Valve Company.
   e. NIBCO INC.; Models S-585-70-66 or T-585-70-66.
2.3 GENERAL SERVICE BUTTERFLY VALVES

A. General: MSS SP-67, for bubble-tight shutoff, extended-neck for insulation, disc and lining suitable for potable water, unless otherwise indicated, and with the following features:

1. Full lug, and grooved valves shall be suitable for bi-directional dead end service at full rated pressure without the use or need of a downstream flange.
2. Valve sizes NPS 2 through NPS 6 shall have lever lock operator; valve sizes NPS 8 and larger shall have weatherproof gear operator.


1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; by Conbraco Industries, Inc.; Series 143 and Series LD 145.
   b. Bray International, Inc.
   c. DeZurik.
   d. Forum Energy Technologies; ABZ Valve.
   e. Hammond Valve.
   f. Milwaukee Valve Company.
   g. NIBCO INC.; LD-2000-3/5.
   h. Pentair Valves & Controls; Keystone.
   i. Tyco Flow Control; Grinnell Flow Control.
   j. Watts Water Technologies.

C. Lug-Style (Single-Flange) Size NPS 14 and Larger, 150-psig CWP Rating, Aluminum-Bronze Disc, EPDM Seat, Ferrous-Alloy Butterfly Valves: Full-lug type with ductile-iron body, one- or two-piece Type 416 stainless-steel stem, bronze bushing, and phenolic-backed EPDM seat (liner) attached to the body.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Apollo Valves; by Conbraco Industries, Inc.;
Series 143 and Series LD 145.
b. Bray International, Inc.
c. Dezurik.
d. Forum Energy Technologies; ABZ Valve.
e. Hammond Valve.
f. Milwaukee Valve Company.
g. NIBCO INC.; LD-1000-5.
h. Pentair Valves & Controls; Keystone.
i. Tyco Flow Control; Grinnell Flow Control.
j. Watts Water Technologies.

2.4 BRONZE CHECK VALVES

A. Bronze Check Valves, General: MSS SP-80.

B. Class 150, Bronze, Swing Check Valves with Bronze Disc: ASTM B-62 bronze body and seat with regrinding-type bronze
disc, Y-pattern design, soldered or threaded end
connections, and having 300 psig CWP rating.

1. Manufacturers: Subject to compliance with
requirements, provide products by one of the
following:

a. Apollo Valves; by Conbraco Industries, Inc.
b. Crane Co.; Crane Valves.
c. Crane Co.; Stockham Div.
d. Hammond Valve.
e. Milwaukee Valve Company; Model 515.
f. NIBCO INC.; Models S-433-B or T-433-B.
g. Watts Water Technologies.

2.5 IRON SWING CHECK VALVES


B. Class 125, Gray-Iron, Standard Swing Check Valves: ASTM A-
126, Class B cast-iron body and bolted bonnet with flanged
end connections; non-asbestos synthetic-fiber gaskets;
bronze disc and seat; and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with
requirements, provide products by one of the
following:

a. Apollo Valves; by Conbraco Industries, Inc.
b. Crane Co.; Crane Valves.
c. Crane Co.; Stockham Div.
d. Hammond Valve.
e. Milwaukee Valve Company; Model F-2974.
f. NIBCO INC.; Model F-918-B.
g. Watts Water Technologies.

C. Class 250, Gray-Iron, Swing Check Valves: ASTM A-126, Class B cast-iron body and bolted bonnet with flanged end connections; non-asbestos synthetic-fiber gaskets; and bronze disc and seat; and having 500 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Valves; by Conbraco Industries, Inc.
   b. Crane Co.; Crane Valves.
   c. Crane Co.; Stockham Div.
   d. Hammond Valve.
   e. Milwaukee Valve Company; Model F-2974.
   f. NIBCO INC.; Model F-918-B.
   g. Watts Water Technologies.

2.6 BRONZE LIFT CHECK VALVES

A. Class 125, Lift Check Valves with Nonmetallic TFE Disc:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Hammond Valve.
   b. Milwaukee Valve Company.
   c. NIBCO INC.; Model S-480-Y or T-480-Y.
   d. The Wm. Powell Company.

2. Description:

   a. Standard: MSS SP-80, Type 2.
   b. CWP Rating: 250 psig.
   e. Ends: Threaded or Solder.
   f. Disc: PTFE, or TFE.
2.7 SPRING-LOADED, CENTER-GUIDED LIFT-DISC (SILENT) CHECK VALVES

A. Lift-Disc Check Valves, General: FCI 74-1 and MIL-V-18436F, with spring-loaded, center-guided bronze disc and seat.

B. Class 125, Wafer, Lift-Disc Check Valves: Wafer style with cast-iron body with diameter made to fit within bolt circle, and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. NIBCO INC.; Model W-910-B.
   b. Mueller Steam Specialty.
   c. Milwaukee Valve Company.
   d. Hammond Valve.

C. Class 125, Globe, Flanged Lift-Disc Check Valves: Globe style with cast-iron body and flanged ends, and having 200 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. NIBCO INC.; Model F-910-B.
   b. Mueller Steam Specialty.
   c. Milwaukee Valve Company.
   d. Hammond Valve.

2.8 BRONZE GLOBE VALVES

A. Bronze Globe Valves, General: MSS SP-80, with malleable-iron handwheel.

B. Class 150, TFE Disc, Bronze Globe Valves: ASTM B-62 bronze body, bonnet, and seat, TFE disc, copper-silicone bronze stem, union-ring bonnet, soldered or threaded end connections; and having 300 psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2.9 BRONZE ANGLE VALVES

A. Bronze Angle Valves, General: MSS SP-80, with silicon bronze stem, non-asbestos packing and malleable-iron handwheel.

B. Class 150, Bronze Angle Valves: ASTM B 62 bronze body with TFE disc, union-ring bonnet, threaded ends, and having 300-psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Crane Co.; Crane Valves.
   b. Crane Co.; Stockham Valves.
   c. Hammond Valve.
   d. Milwaukee Valve Company; Model 595T.
   e. NIBCO INC.; Model T-335-Y.
   f. The Wm. Powell Company.

2.10 CAST-IRON ANGLE VALVES

A. Cast-Iron Angle Valves, General: MSS SP-85, Type II; having ASTM A 126, Class B cast-iron body and bolted bonnet; bronze mounted, non-asbestos packing and gaskets; and flanged-end connections.

B. Class 125, Cast-Iron, Standard Angle Valves: 200-psig CWP rating.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. NIBCO INC.; Model F-818-B.
   b. Crane Co.; Stockham Valves.
   c. Crane Co.; Crane Valves.
2.11 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves
   1. Bronze ball valve as specified in this Section.
   2. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.12 CHAINWHEEL ACTUATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Babbitt Steam Specialty Co.
   2. Roto Hammer Industries, Inc.

B. Description: Valve actuation assembly with sprocket rim, brackets, and chain.
   1. Sprocket Rim with Chain Guides: Ductile iron, of type and size required for valve. Include zinc coating.
   2. Brackets: Type, number, size, and fasteners required to mount actuator on valve.
   3. Chain: Hot-dip, galvanized steel, of size required to fit sprocket rim.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.
D. Examine threads on valve and mating pipe for form and cleanliness.

E. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

F. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE APPLICATIONS

A. Refer to Drawings.

3.3 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.

D. Install valves in horizontal piping with stem at or above center of pipe. Butterfly valves shall be installed with stem horizontal to allow support for the disc and the cleaning action of the disc.

E. Install valves in position to allow full stem movement.

F. Install chainwheel operators on valves NPS 4 and larger and more than 84 inches above floor. Extend chains to 60 inches above finished floor elevation.

G. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.
2. Dual-Plate Check Valves: In horizontal or vertical position, between flanges.
3. Lift Check Valves: With stem upright and plumb.

3.4 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.5 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

END OF SECTION 15112
SECTION 15121 - PIPE FLEXIBLE CONNECTORS, EXPANSION FITTINGS AND LOOPS

PART 1 - GENERAL

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

B. Related Sections include the following:
   1. Division 15 Section “Mechanical General Requirements.”
   2. Division 15 Section “Basic Mechanical Materials and Methods.”
   3. Division 15 Section “Refrigerant Piping.”

1.2 DEFINITIONS
A. BR: Butyl rubber.
B. CR: Chlorosulfonated polyethylene synthetic rubber (Neoprene).

C. CSM: Chlorosulfonyl-polyethylene rubber (Hypalon).

D. EPDM: Ethylene-propylene-diene terpolymer rubber.

E. NBR: Buna-N/Nitrile rubber.

F. NR: Natural rubber.

G. PTFE: Polytetrafluoroethylene plastic.

1.3 PERFORMANCE REQUIREMENTS

A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.

B. Capability: Products shall absorb 150 percent of maximum axial movement between anchors.

1.4 SUBMITTALS

A. Product Data: For each type of pipe flexible connector, expansion joint and alignment guide indicated.

B. Delegated-Design Submittal:

1. Design calculations and detailed fabrication and assembly of pipe anchors and alignment guides for multiple pipes, expansion joints and loops, and attachments of the same to the building structure.

2. Locations of pipe anchors and alignment guides and expansion joints and loops.

C. Shop Drawings: Signed and sealed by a qualified professional engineer.

1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.

2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.

3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

D. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.

E. Welding certificates.

F. Operation and Maintenance Data: For pipe expansion joints to include in operation and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components - Lead Content for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.
2.2 FLEXIBLE CONNECTORS


1. Manufacturers:
   a. Flex-Weld, Inc./Keflex.
   c. Metraflex, Inc.
   d. Senior Flexonics, Inc.; Pathway Division.
   e. Twin City Hose, Inc.
   f. Vibration Mountings & Controls, Inc.

2. Arch Type: Single or multiple arches.
3. Spherical Type: Single or multiple spheres.

   a. Minimum Pressure and Temperature Ratings for NPS 1-1/2 to NPS 4: 150 psig at 220 deg F.
   b. Minimum Pressure and Temperature Ratings for NPS 5 and NPS 6: 140 psig at 200 deg F.
   c. Minimum Pressure and Temperature Ratings for NPS 8 to NPS 12: 140 psig at 180 deg F.

4. Material: EPDM.

B. PTFE Flexible Connectors/Expansion Joints: Molded PTFE bellows with external reinforcing rings and external limit bolts.

1. Manufacturers:
   a. Flex-Weld, Inc./Keflex.
   c. Metraflex, Inc.
   d. Senior Flexonics, Inc.; Pathway Division.
   e. Twin City Hose, Inc.
   f. Vibration Mountings & Controls, Inc.

2. Arch Type: Single or multiple arches.
C. Metal-Bellows Flexible Connectors: Circular-corrugated-bellows type with external tie rods and compression stops.

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Weld, Inc./Keflex.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
   e. Senior Flexonics, Inc.; Pathway Division.
   f. Twin City Hose, Inc.


3. Minimum Pressure Rating: 150 psig, unless otherwise indicated.

4. Maximum Temperature Rating: 850 deg F.

5. End Connections: Flanged

D. Hose and Braid Flexible Connectors:

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Weld, Inc.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
   e. Senior Flexonics, Inc.; Pathway Division.
   f. Twin City Hose, Inc.

2. Flexible Connectors for Copper Piping: Multiple-ply phosphor-bronze corrugated hose with bronze outer braid, copper ferrule, and copper pipe end connections.

3. Flexible Connectors for Steel Piping: Multiple-ply stainless-steel corrugated hose with stainless steel outer braid, and steel pipe end connections.

4. Minimum Pressure Rating: 150 psig, unless otherwise indicated.


2.3 EXPANSION JOINTS

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Weld, Inc./Keflex.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
   e. Senior Flexonics, Inc.; Pathway Division.
   f. Twin City Hose, Inc.

4. Minimum Pressure Rating: 200 psig, unless otherwise indicated.
5. Maximum Temperature Rating: 650 deg F.
6. Configuration: Single- or double -bellows type, unless otherwise indicated.
7. End Connections: Threaded, Flanged or weld.


1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Weld, Inc./Keflex.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
   e. Senior Flexonics, Inc.; Pathway Division.
   f. Twin City Hose, Inc.

2. Metal-Bellows Expansion Joints for Steel Piping: Multiple-ply or laminated stainless-steel bellows, steel pipe end connections, internal guide ring and stop, and carbon-steel shroud with drain plug.
3. Minimum Pressure Rating: 200 psig, unless otherwise indicated.
4. Maximum Temperature Rating: 750 deg F.
5. Configuration: Single- or double -bellows type, unless otherwise indicated.
6. End Connections: Flanged or weld.
C. Expansion Compensators: Double-ply corrugated steel, stainless-steel, or copper-alloy bellows in a housing with internal guides, antitorque device, and removable end clip for positioning.

1. Manufacturers:

   a. Adsco Manufacturing, LLC.
   b. Flex-Weld, Inc./Keflex.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
   e. Senior Flexonics, Inc.; Pathway Division.
   f. Twin City Hose, Inc.

2. Minimum Pressure Rating: 200 psig, unless otherwise indicated.

3. Configuration for Copper Piping: Two-ply stainless-steel bellows and bronze or stainless-steel shroud.


5. End Connections for Copper Tubing NPS 2 and Smaller: Solder joint.

6. End Connections for Copper Tubing NPS 2-1/2 to NPS 4: Solder joint.


8. End Connections for Steel Pipe NPS 2-1/2 to NPS 4: Flanged or Weld.

D. Flexible-Hose Expansion Joints: Manufactured assembly with two flexible-metal-hose legs joined by long-radius, 180-degree return bend or center section of flexible hose; with inlet and outlet elbow fittings, corrugated-metal inner hoses, and braided outer sheaths.

1. Manufacturers:

   a. Flex-Hose Co., Inc.
   b. Metraflex, Inc.; Metraloop.
   c. Twin City Hose, Inc.

2. Flexible-Hose Expansion Joints for Copper Piping: Copper-alloy fittings with solder- or brazed-joint end connections.
a. NPS 2 and Smaller: Bronze hoses and single-braid bronze sheaths with minimum 300 psig at 70 deg F and 230 psig at 400 deg F ratings.
b. NPS 2-1/2 to NPS 4: Stainless-steel hoses and single-braid, stainless-steel sheaths with minimum 230 psig at 70 deg F and 180 psig at 400 deg F ratings.

E. Packed Slip Expansion Joints: ASTM F 1007, carbon-steel, packing type designed for repacking under pressure and pressure rated for 250 psig at 400 deg F minimum. Include asbestos-free PTFE packing compound, limit stops, and drip connection if used for steam piping.

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Advanced Thermal Systems, Inc.
   c. Hyspan Precision Products, Inc.
   d. Tyco Flow Control; Yarway.

2. Configuration: Single- and double-joint class with base, unless otherwise indicated.
3. End Connections: Flanged or weld ends to match piping system.

F. Flexible Ball Joints: Carbon-steel assembly with asbestos-free composition packing, designed for 360-degree rotation and angular deflection, and 250 psig at 400 deg F minimum pressure rating; complying with ASME Boiler and Pressure Vessel Code: Section II, "Materials," and with ASME B31.9, "Building Services Piping," for materials and design of pressure-containing parts and bolting.

1. Manufacturers:
   a. Advanced Thermal Systems, Inc.
   b. Hyspan Precision Products, Inc.; Barco.

2. Angular Deflection for NPS 6 and Smaller: 30-degree minimum.
3. Angular Deflection for NPS 8 and Larger: 15-degree minimum.
4. End Connections for NPS 2 and Smaller: Threaded.
5. End Connections for NPS 2-1/2 and Larger: Flanged.

2.4 ALIGNMENT GUIDES

A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

1. Manufacturers:
   a. Adsco Manufacturing, LLC.
   b. Flex-Weld, Inc.
   c. Hyspan Precision Products, Inc.
   d. Metraflex, Inc.
   e. Senior Flexonics, Inc.; Pathway Division.

2.5 SLIDING/GUIDING DEVICES

A. For pipe size 4 inch and smaller on all hot piping, provide guides equal to Flexonics semi-steel spider and guiding cylinder pipe alignment guides for all expansion joints and loops. Provide pipe alignment guides in quantities at all locations as required according to the manufacturer’s design criteria and recommendations. Pipe alignment guides shall serve to guide the expansion joints, loops or bends.

PIPE FLEXIBLE CONNECTORS, EXPANSION FITTINGS AND LOOPS 15121 - 9
1. Manufacturers:
   a. B-Line Systems, Inc.; a Division of Cooper Industries; Figure 3281 Series.
   b. Senior Flexonics.
   c. Sypris Technologies; Tube Turns Division;
   d. U.S. Flexible Metallic Tubing Co., Kelflex Type M.
   e. Metraflex, Inc.

B. For pipe sizes 6 inches and above and all guides on cold piping, furnish pre-engineered pre-insulated guides with published vertical and lateral load ratings. Construction shall consist of an insulated shield containing structural calcium silicate (100 psi non-load bearing and 600 psi load bearing) encased in 360 degrees of overlapping sheet metal. A 36 steel clamps torqued onto insulated shield with recommended catalog torque valves. Slide service shall be stainless steel to polyethylene or Teflon with a maximum coefficient of friction of 0.15.

1. Manufacturers:
   b. Carpenter and Paterson, Inc.

2.6 MATERIALS FOR ANCHORS

A. Steel Shapes and Plates: ASTM A 36/A 36M.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.

   2. Expansion Plug: Zinc-coated steel.
E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.

1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.

F. Concrete: Portland cement mix, 3000 psi minimum. Refer to Division 03 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.

G. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 FLEXIBLE CONNECTOR APPLICATIONS

A. Use rubber flexible pipe connectors at the inlet and outlet water connections of base mounted pumps, chillers, and cooling towers, unless otherwise indicated.

1. Rubber Flexible Connectors for Pipe Sized NPS 2 and Smaller: Twin-sphere with females union end connections.
2. Rubber Flexible Connectors for Pipe Sized NPS 2-1/2 and Larger: Twin-sphere with floating flange end connections.

B. Use hose and braid flexible pipe connectors at the inlet and outlet water connections of base mounted pumps, chillers, and cooling towers, unless otherwise indicated.

1. Flexible Connectors: Stainless steel hose and braid style with threaded end connections for pipe sized NPS 2 and smaller.
2. Flexible Connectors: Stainless steel hose and braid style with steel flange end connections for pipe sized NPS 2-1/2 and larger.

C. Flexible Connectors for Steam and Steam Condensate Service: Stainless steel hose and braid style with threaded end connections for pipe sized NPS 2 and smaller, and steel flange end connections for pipe sized NPS 2-1/2 and larger. Overall length sufficient to provide 1-1/2 inch offset.

D. Flexible Pipe Connectors for Refrigerant Pipe: Refer to Division 15 Section “Refrigerant Piping.”

3.2 EXPANSION-JOINT INSTALLATION

A. Install manufactured, nonmetallic expansion joints according to FSA's "Technical Handbook: Non-Metallic Expansion Joints and Flexible Pipe Connectors."

B. Install expansion joints of sizes matching size of piping in which they are installed.

C. Install alignment guides to allow expansion and to avoid end-loading and torsional stress.

D. Install alignment guides at spacing recommended by expansion joint manufacturer.

E. Control expansion joint movement by installing two rigid pipe guides on each side of the expansion joint. Spacing shall be as follows:
Nom. Exp. Pipe Joint 1st to Maximum Distance Between Intermediate Guides Size to 2nd (Ft.) For Tabulated pressures, PSIG 1st

<table>
<thead>
<tr>
<th>(In.)</th>
<th>Guide</th>
<th>Guide</th>
<th>50</th>
<th>100</th>
<th>150</th>
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3.3 PIPE BEND AND LOOP INSTALLATION

A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Attach pipe bends and loops to anchors.


2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.4 SWING CONNECTIONS

A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.

B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.
3.5 ALIGNMENT-GUIDE INSTALLATION

A. Install guides on piping adjoining pipe expansion joints and bends and loops.

B. Attach guides to pipe and secure to building structure.

3.6 ANCHOR INSTALLATION

A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.

D. Install pipe anchors according to expansion-joint manufacturer's written instructions if expansion joints or compensators are indicated.

E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION 15121
SECTION 15122 - METERS AND GAGES

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 2 Section "Water Distribution" for domestic and fire-protection water service meters outside the building.
2. Division 13 15 Section “Fire-Suppression Piping” for listed or approved pressure gages.
3. Division 15 Section "Mechanical General Requirements."
4. Division 15 Section “Basic Mechanical Materials and Methods."
5. Division 15 Section "Domestic Water Piping" for domestic and fire-protection water service meters inside the building.
6. Division 15 Section "Fuel Gas Piping" for gas utility meters.

1.2 DEFINITIONS

A. CR: Chlorosulfonated polyethylene synthetic rubber.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. FPR: Fiberglass reinforced plastic.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated; include performance curves.

B. Shop Drawings: Schedule for thermometers, gages and flowmeters indicating manufacturer's number, scale range, and location for each.

C. Product Certificates: For each type of thermometer, gage, and flowmeter, signed by product manufacturer.

D. Operation and Maintenance Data: For flowmeters to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components - Lead Content for potable domestic water piping and components.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 METAL-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
3. REOTEMP Instrument Corporation.
4. Trerice, H. O. Co.
5. Weiss Instruments, Inc.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Die-cast aluminum or Chrome-plated brass, 9 inches long.

C. Tube: Red, blue, or green reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass or plastic.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Copper-plated steel, aluminum, or brass for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.3 PLASTIC-CASE, LIQUID-IN-GLASS THERMOMETERS

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Marsh Bellofram.
3. Miljoco Corp.
4. REOTEMP Instrument Corporation.
5. Trerice, H. O. Co.
6. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.

B. Case: Plastic, 9 inches long.

C. Tube: Red, blue, or green reading, organic-liquid filled, with magnifying lens.

D. Tube Background: Satin-faced, nonreflective aluminum with permanently etched scale markings.

E. Window: Glass or plastic.

F. Connector: Adjustable type, 180 degrees in vertical plane, 360 degrees in horizontal plane, with locking device.

G. Stem: Metal, for thermowell installation and of length to suit installation.

H. Accuracy: Plus or minus 1 percent of range or plus or minus 1 scale division to maximum of 1.5 percent of range.

2.4 THERMOWELLS

A. Manufacturers: Same as manufacturer of thermometer being used.

B. Description: Pressure-tight, socket-type metal fitting made for insertion into piping and of type, diameter, and length required to hold thermometer. Brass for compatible services less than 353 degrees F (178 degrees C); ANSI 18-8 stainless steel for all others to suit service. Furnish extension neck to accommodate insulation where applicable.

2.5 PRESSURE GAGES

A. Manufacturers:

1. AMETEK, Inc.; U.S. Gauge Div.
2. Cambridge.
3. Dwyer Instruments, Inc.
5. Miljoco Corporation.
6. Trerice, H. O. Co.
7. Weiss Instruments, Inc.
8. Weksler Instruments Operating Unit; Dresser Industries; Instrument Div.
B. Direct-Mounting, Dial-Type Pressure Gages: Indicating-dial type complying with ASME B40.100.

1. Case: Stainless steel, aluminum, or FRP, 4-1/2-inch diameter.
2. Pressure-Element Assembly: Bourdon tube, unless otherwise indicated.
3. Pressure Connection: Brass, NPS 1/4, bottom-outlet type unless back-outlet type is indicated.
4. Movement: Mechanical, with link to pressure element and connection to pointer.
5. Dial: Satin-faced, non-reflective aluminum with permanently etched scale markings.
6. Pointer: Red or other dark-color metal.
7. Window: Glass or plastic.
8. Ring: Stainless steel or chrome plated metal.
9. Accuracy: Grade A, plus or minus 1 percent of middle half scale.
10. Water: 0-100 PSIG (1 psi divisions to 50 psi; 5 psi divisions above 50 psi), liquid filled.
11. Range for Fluids under Pressure: 1-1/2 times expected working pressure. If not a standard scale, select next largest scale.

C. Pressure-Gage Fittings:

1. Valves: NPS 1/4 brass ball type.
2. Syphons: NPS 1/4 coil of brass tubing with threaded ends.
3. Snubbers: ASME B40.5, NPS 1/4 brass bushing with corrosion-resistant, porous-metal disc of material suitable for system fluid and working pressure.

2.6 TEST PLUGS

A. Manufacturers:

1. Peterson Equipment Co., Inc.

B. Description: Corrosion-resistant brass or stainless-steel body with core inserts and gasketed and threaded cap, with extended stem for units to be installed in insulated piping.
C. Minimum Pressure and Temperature Rating: 500 psig at 200 deg F for cold services, and 500 psig at 275 deg F for hot services.

D. Core Inserts: One or two self-sealing rubber valves.
   1. Insert material for air, water, oil, or gas service at 20 to 200 deg F shall be Neoprene.
   2. Insert material for air or water service at minus 30 to plus 275 deg F shall be Nordel.

E. Test Kit: Furnish test kit(s) containing one pressure gage and adaptor, thermometer(s), and carrying case. Pressure gage, adapter probes, and thermometer sensing elements shall be of diameter to fit test plugs and of length to project into piping.
   1. Pressure Gage: Small bourdon-tube insertion type with 2- to 3-inch- diameter dial and probe. Dial range shall be 0 to 200 psig.
   2. Low-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 25 to 125 deg F.
   3. High-Range Thermometer: Small bimetallic insertion type with 1- to 2-inch- diameter dial and tapered-end sensing element. Dial ranges shall be 0 to 220 deg F.
   4. Carrying case shall have formed instrument padding.

2.7 FLOW MEASURING DEVICES

A. Manufacturers:
   1. Dietrich Standard Subsidiary of Rosemount Division of Emerson Process Management; Diamond II - Flo-Tap Model.
   2. Preso Meters Corporation.
   3. Taco, Inc.

B. Flow measuring device shall be used where indicated on the drawings and in sizes NPS 6 and larger and shall be annular primary flow elements. The annular primary flow elements shall be type 316, stainless steel, diamond shape or elliptical shape in cross-section. Pressure rating shall meet or exceed system minimum pressure rating as indicated for each system. Provide permanent, rust-proof metal identification tag on a chain indicating design flow rates, metered fluid and line size. Flow measuring devices
shall be weld insert type. Units shall be capable of being inserted without system shut-down.

C. Accuracy shall be plus or minus 1 percent over a flow turndown at least 10 to 1, independent of Reynold's number. Repeatability shall be plus or minus 0.1 percent.

D. Sensors shall be installed in strict accordance with the manufacturer's recommendations with special attention given to alignment and straight run requirements.

E. Flow measuring device in chilled water system de-coupler pipe shall have bi-directional flow measurement capability, or two uni-directional devices shall be provided.

F. Flow gages which read in actual GPM shall be provided for all flow measuring devices on pumps 200 GPM or larger, and for both flow directions on the chilled water system de-coupler pipe flow measuring device. Gage scale shall be linear to flow. Maximum flow rate on scale shall be selected at 120 percent of the pump's scheduled flow rate (120 percent of the scheduled flow rate of one chiller for the chilled water system de-coupler). Gage scale shall be 2.5 inch x 6 inch minimum, or 4 inch diameter minimum, and shall be mounted at eye level on unistrut support.

2.8 MAGNETIC INDUCTIVE FLOWMETER (INSERTION TYPE)

A. Manufacturers:

2. KROHNE (Metrol Company, Detroit, MI; 313-365-5400).

B. Description: Magnetic inductive flowmeter for measuring the flow of conductive liquids in pipes and suitable for installation in pipes size NPS 1-1/2 to NPS 12.

C. Input Power: 24 VDC, 2.5 watts.

D. Current Output: 4-20mA, active bi-directional measurement, output always positive.

E. Temperature Ratings:

1. Ambient Temperature: 140 deg F maximum.
2. Measured Fluid Temperature: 0 to 212 deg F.

F. Pressure Rating: 230 psig at 75 deg F.

G. Transmitter Span: 1-5 meters/second (adjustable).

H. Accuracy: Plus or minus 2 percent of velocity at the measuring electrode.

I. Repeatability: Plus or minus 2 percent of measured value.

J. Noise Immunity: CE per EN 50081-1-2 and EN 50082-1-2.

K. Electrical Protection (Enclosure) Type: NEMA 4X/IP 65.

L. Wetted Parts:
   2. Electrodes: Type 316 L stainless steel.
   3. Flow Transmitter: Provided with Type 316L stainless steel weld sleeve.
   4. Sealing Ring: Buna-N.

M. Case: Aluminum, epoxy powder coated.

PART 3 - EXECUTION

3.1 THERMOMETER APPLICATIONS

A. Install liquid-in-glass thermometers in the following locations:
   1. Inlet and outlet of each hydronic zone.
   2. Inlet and outlet of each hydronic boiler.
   3. Outside-air, return-air, and mixed-air ducts.

B. Provide the following temperature ranges for thermometers:
   1. Domestic Hot Water: 30 to 180 deg F, with 2-degree scale divisions.
   2. Domestic Cold Water: 0 to 100 deg F, with 2-degree scale divisions.
   3. Heating Hot Water: 30 to 240 deg F, with 2-degree scale divisions.
   4. Air Ducts: Minus 40 to plus 110 deg F, with 2-degree scale divisions.
3.2 GAGE APPLICATIONS

A. Install dry-case-type pressure gages on inlet and outlet of each pressure-reducing valve.

B. Install liquid-filled-case-type pressure gages at suction and discharge of each pump.

C. Except where noted otherwise, select range for twice normal operating pressure.
   1. Water (CW and HW): 0 to 100 psig.
   2. Steam (15 pounds): 30 inches mercury vacuum to 30 psig.
   3. Steam (60 pounds): 30 inches mercury vacuum to 100 psig.
   4. Compressed Air: 0 to 100 psig.

3.3 INSTALLATIONS

A. Install direct-mounting thermometers and adjust vertical and tilted positions.

B. Install thermowells with socket extending a minimum of 2 inches into fluid and in vertical position in piping tees where thermometers are indicated.

C. Duct Thermometer Support Flanges: Install in wall of duct where duct thermometers are indicated. Attach to duct with screws.

D. Install direct-mounting pressure gages in piping tees with pressure gage located on pipe at most readable position.

E. Install ball valve and snubber fitting in piping for each pressure gage for fluids (except steam).

F. Install ball valve and syphon fitting in piping for each pressure gage for steam.

G. Install test plugs in tees in piping.

H. Install flow indicators, in accessible positions for easy viewing, in piping systems.
I. Assemble and install connections, tubing, and accessories between flow-measuring elements and flowmeters as prescribed by manufacturer's written instructions.

J. Install flowmeter elements in accessible positions in piping systems.

K. Install differential-pressure-type flowmeter elements with at least minimum straight lengths of pipe upstream and downstream from element as prescribed by manufacturer's written instructions.

L. Install wafer-orifice flowmeter elements between pipe flanges.

M. Install permanent indicators on walls or brackets in accessible and readable positions.

N. Install connection fittings for attachment to portable indicators in accessible locations.

O. Install flowmeters at discharge of hydronic system pumps and at inlet of hydronic air coils.

P. Assemble components and install thermal-energy meters.

Q. Mount meters on wall if accessible; if not, provide brackets to support meters.

3.4 CONNECTIONS

A. Install meters and gages adjacent to machines and equipment to allow service and maintenance for meters, gages, machines, and equipment.

B. Connect flowmeter-system elements to meters.

C. Connect flowmeter transmitters to meters.

D. Connect thermal-energy-meter transmitters to meters.

E. Ground equipment according to Division 16 Section "Grounding and Bonding."

F. Connect wiring according to Division 16 Section "Conductors and Cables."
3.5 ADJUSTING

A. Calibrate meters according to manufacturer's written instructions, after installation.

B. Adjust faces of meters and gages to proper angle for best visibility.

END OF SECTION 15122
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 02 Section “Water Distribution” for water-service piping and water meters outside the building and for water service entrance piping.
2. Division 15 Section “Mechanical General Requirements.”
3. Division 15 Section “Basic Mechanical Materials and Methods” for materials and methods common to mechanical piping systems.
4. Division 15 Section “Hangers and Supports.”
5. Division 15 Section “Meters and Gages” for thermometers, pressure gages, and fittings.
6. Division 15 Section “Plumbing Valves” for general duty plumbing valves.
7. Division 15 Section “Domestic Water Piping Specialties” for water distribution piping specialties.
8. Division 15 Section “Water Distribution” for water-service piping and water meters outside the building and for water service entrance piping.

1.2 SUMMARY

A. This Section includes domestic water piping and water meters inside the building.

B. Water meters will be furnished and installed by utility company.

C. Water meters will be furnished by utility company for installation by Contractor.

1.3 DEFINITIONS

A. PEX: Crosslinked polyethylene plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Where not indicated on the Drawings, provide components and installation capable of producing domestic water piping systems with 125 psig, unless otherwise indicated.

1.5 SYSTEMS DESCRIPTION

A. Potable and non-potable domestic water piping system materials are scheduled on the Drawing.

B. Under-Building-Slab, Water-Service Piping on Service Side of Water Meter: Refer to Division 02 Section "Water Distribution."
C. Refer to Application Schedules on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:

2. Drain Duty: Hose-end drain valves.
3. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2 and Smaller: Class 150, bronze.
4. Isolation Valves at Domestic Water Meters: Gate Valves, NPS 2-1/2 and Larger: Class 125, OS&Y, bronze-mounted cast iron.

D. Transition and special fittings with pressure ratings at least equal to piping rating may be used unless otherwise indicated.

1.6 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.


C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Fire-suppression-water piping.
2. Domestic water piping.
3. HVAC hydronic piping.

D. Field quality-control test reports.

1.7 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372
Drinking Water System Components – Lead Content for potable domestic water piping and components.

D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Transition Couplings for Aboveground Pressure Piping: Coupling or other manufactured fitting the same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

2.3 COPPER TUBE AND FITTINGS

A. Soft Copper Tube: ASTM B 88, Type K, water tube, annealed temper.


2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.

3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-
metal seating surfaces, and solder-joint or threaded ends.

B. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.


2. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends. Furnish Class 300 flanges if required to match piping.

3. Copper Unions: MSS SP-123, cast-copper-alloy, hexagonal-stock body, with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

C. Copper or Bronze Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Viega North America; ProPress System.
   b. NIBCO Inc.; Press System.
   c. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.
   d. Apollo Valves; by Conbraco Industries; ApolloXpress.

2. Housing: Copper.

3. O-Rings and Pipe Stops: EPDM.

4. Tools: Manufacturer's special tools.

5. Maximum 200-psig working-pressure rating at 250 deg F.

D. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube. Mechanically formed tee fittings may be used up to half size of main.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. T-DRILL Industries Inc.
2.4 GALVANIZED STEEL PIPE AND FITTINGS

A. Galvanized Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade A or B, Schedule 40. Include ends matching joining method.


2.5 VALVES

A. General-duty plumbing valves; and drain valves are specified in Division 15 Section "Plumbing Valves."

B. Balancing valves are specified in Division 15 Section "Domestic Water Piping Specialties."

2.6 SPECIALTY VALVES

A. Bronze Gate Valves: MSS SP-80, with malleable-iron handwheel.

1. Class 150, Rising-Stem, Bronze Gate Valves: ASTM B-62 bronze body, bonnet, and wedge, copper-silicone bronze stem, screw-in bonnet, threaded end connections; and having 300 psig CWP rating.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Crane Valve Group; Crane Valves.
2) Hammond Valve.
3) Milwaukee Valve Company; Model 1150.
4) NIBCO INC.; Models T-131, S-134 or T-134.
2.7 WATER METERS

A. Refer to Division 15 Section “Mechanical General Requirements.”

B. Displacement-Type Water Meters NPS 2 and Smaller: AWWA C700, nutating-disc totalization meter with bronze case and 150-psig minimum working-pressure rating; with registration in gallons or cubic feet as required by utility; and with threaded end connections.

1. Manufacturers:
   a. AALIANT; a Venture Measurement Product Line; Niagara.
   b. Badger Meter, Inc.
   c. Sensus Metering Systems Inc.

C. Turbine-Type Water Meters: AWWA C701, totalization meter with 150-psig minimum working-pressure rating; with registration in cubic feet as required by utility; and with the following end connections:

1. NPS 2 and Smaller: Threaded.
2. NPS 2-1/2 and Larger: Flanged.
3. Manufacturers:
   a. AALIANT; a Venture Measurement Product Line; Niagara.
   b. Badger Meter, Inc.
   c. Sensus Metering Systems Inc.

D. Compound-Type Water Meters NPS 3 and Larger: AWWA C702, totalization meter with integral main-line and bypass meters, bronze case, and 150-psig minimum working-pressure rating; with registration in cubic feet as required by utility; and with flanged end connections.

1. Manufacturers:
   a. Badger Meter, Inc.
   b. Sensus Metering Systems Inc.
   c. Kent/AMCO.

E. Remote Registration System: Direct-reading type complying with AWWA C706; modified with signal transmitting
assembly, low-voltage connecting wiring, and remote register assembly as required by utility.

F. Remote Registration System: Encoder-type complying with AWWA C707; modified with signal transmitting assembly, low-voltage connecting wiring, and remote register assembly as required by utility.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Excavating, trenching, and backfilling are specified in Division 02 Section "Earthwork."

3.2 PIPING SYSTEM INSTALLATION

A. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Bury service entrance piping with depth of cover over top of pipe at least 72 inches, and with top of pipe at least 12 inches below level of maximum frost penetration; and in accordance with authorities having jurisdiction.

C. Install under-building-slab copper tubing according to Copper Development Association’s "Copper Tube Handbook." Joints under slab are not allowed. Install PVC sleeve where piping penetrates slab.

D. Install sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section "Basic Mechanical Materials and Methods."

E. Install wall penetration system at each service pipe penetration through foundation wall. Make installation watertight. Wall penetration systems are specified in Division 15 Section "Basic Mechanical Materials and Methods."

F. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Pressure
gages are specified in Division 15 Section "Meters and Gages," and strainers are specified in Division 15 Section "Domestic Water Piping Specialties."

G. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops.

H. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping.
   1. Install hose-end drain valves at low points in water mains, risers, and branches.
   2. Install stop-and-waste drain valves where indicated.

I. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Calibrated balancing valves are specified in Division 15 Section "Domestic Water Piping Specialties."

J. Install water-pressure regulators downstream from shutoff valves. Water-pressure regulators are specified in Division 15 Section "Domestic Water Piping Specialties."

K. Install domestic water piping level with 0.25 percent slope downward toward drain without pitch and plumb.

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. PEX Piping Joints: Join according to ASTM F 1807.

3.4 WATER METER INSTALLATION

A. Rough-in domestic water piping for water meter installation according to utility company's requirements.

B. Water meters will be furnished and installed by utility company.
C. Install water meters according to AWWA M6 and utility's requirements.

1. Install displacement-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.

2. Install turbine-type water meters with shutoff valve on water-meter inlet. Install valve on water-meter outlet and valved bypass around meter unless prohibited by authorities having jurisdiction.

3. Install compound-type water meters with shutoff valves on water-meter inlet and outlet and on valved bypass around meter. Support meters, valves, and piping on brick or concrete piers.

4. Install fire-service water meters with shutoff valves on water-meter inlet and outlet and on full-size valved bypass around meter. Support meter, valves, and piping on brick or concrete piers.

5. Install remote registration system according to standards of utility and of authorities having jurisdiction.

3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support devices are specified in Division 15 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.

2. Individual, Straight, Horizontal Piping Runs: According to the following:

   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer than 100 Feet: MSS Type 49, spring cushion rolls, if indicated.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section "Hangers and Supports."
C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, to a minimum of 3/8 inch.

E. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4 and Smaller: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6: 12 feet with 3/4-inch rod.
8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

F. Install supports for vertical steel piping every 15 feet.

G. Install hangers for drawn-temper copper tubing with the following maximum horizontal spacing and minimum rod diameters:

2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.
6. NPS 6: 10 feet with 5/8-inch rod.
7. NPS 8: 10 feet with 3/4-inch rod.

H. Install supports for vertical copper tubing every 10 feet.

I. Soft copper tube: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.

J. Alternate support for copper tubing NPS 3/4 and smaller: Continuous support using v-shaped plastic pipe channel, maximum hanger spacing 8 feet with 3/8-inch rod.

K. Install hangers for Schedule 10 stainless steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 84 inches with 3/8-inch rod.
2. NPS 2-1/2: 84 inches with 1/2-inch rod.
3. NPS 3: 96 inches with 1/2-inch rod.
4. NPS 4: 10 feet with 5/8-inch rod.
5. NPS 6: 11 feet with 3/4-inch rod.
6. NPS 8: 12 feet with 7/8-inch rod.
7. NPS 10 to NPS 12: 14 feet with 7/8-inch rod.

L. Install supports for vertical Schedule 10 stainless steel piping every 15 feet.

M. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect domestic water piping to distribution side of water meter with shutoff valve.

C. Connect domestic water piping to existing domestic water distribution piping. Use dielectric fitting if connection dissimilar metals. Refer to Application Schedule on the Drawings and Division 15 Section “Basic Mechanical Materials and Methods” for dielectric fittings.

D. Install piping adjacent to equipment and machines to allow service and maintenance.

E. Connect domestic water piping to the following:

1. Water Heaters: Cold-water supply and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Refer to Division 15 Section "Plumbing Fixtures."
3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.
3.7 FIELD QUALITY CONTROL

A. Inspect domestic water piping as follows:

1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
   a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

B. Test domestic water piping as follows:

1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 150 psig. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.8 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.9 CLEANING AND DISINFECTION

A. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

B. Clean and disinfect potable and non-potable domestic water piping as follows:

1. Purge new piping and parts of existing domestic water piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction or, if methods are not prescribed, procedures described in either AWWA C651 or AWWA C652 or as described below:
a. Flush piping system with clean, potable water until dirty water does not appear at outlets.

b. Fill and isolate system according to either of the following:

1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.

2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.

d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities.

END OF SECTION 15140
SECTION 15145 - DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”
3. Division 15 Section "Meters and Gages" for thermometers, pressure gages, and flow meters in domestic water piping.
4. Division 15 Section "Domestic Water Piping" for water meters.
5. Division 15 Section "Drinking Fountains and Water Coolers" for water filters for water coolers.

1.2 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Flow Reports and Settings: For calibrated balancing valves.

E. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

C. NSF Compliance:


2. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 - PRODUCTS

2.1 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
   a. Apollo Valves; Conbraco Industries, Inc.
   b. FEBCO; a Division of Watts Water Technologies, Inc.
   c. Watts Water Technologies, Inc.; Watts Regulator Co.
   d. Zurn Plumbing Products Group; Wilkins Div.

3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
5. Inlet and Outlet Connections: Threaded.
6. Finish: Chrome plated.

B. Hose-Connection Vacuum Breakers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Apollo Valves; Conbraco Industries, Inc.
   b. MIFAB, Inc.
   c. Watts Water Technologies, Inc.; Watts Regulator Co.
   d. Woodford Manufacturing Company.

3. Body: Bronze or brass, nonremovable, with manual drain.
5. Finish: Chrome or nickel plated.

C. Pressure Vacuum Breakers:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; Conbraco Industries, Inc.
   b. FEBCO; a Division of Watts Water Technologies, Inc.
   c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
   d. Watts Water Technologies, Inc.; Watts Regulator Co.
   e. Zurn Plumbing Products Group; Wilkins Div.

3. Operation: Continuous-pressure applications.
4. Pressure Loss: 5 psig maximum, through middle 1/3 of flow range.
5. Size and Capacity: As indicated on the drawings.
6. Accessories:
   a. Valves: Ball type, on inlet and outlet.

2.2 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Apollo Valves; Conbraco Industries, Inc.
   b. FEBCO; a Division of Watts Water Technologies, Inc.
   c. Watts Water Technologies, Inc.; Ames Fire & Waterworks.
   d. Watts Water Technologies, Inc.; Watts Regulator Co.
   e. Zurn Plumbing Products Group; Wilkins Div.

3. Operation: Continuous-pressure applications.
4. Pressure Loss: 12 psig maximum, through middle 1/3 of flow range.
5. Size and Capacities: As scheduled on the drawings.
6. Body: Bronze for NPS 2 and smaller; cast-iron or ductile-iron, with interior lining complying with
A. Calibrated Balancing Valves NPS 1/2:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Armstrong Pumps, Inc.
      c. Apollo Valves; by Conbraco Industries, Inc.
      d. Bell & Gossett; Xylem Inc.
      e. Flo Fab Inc.
      f. Flow Design Inc.
      g. Griswold Controls.
      h. NIBCO INC.
      i. IMI Indoor Climate; Tour & Andersson.
      j. Taco, Inc.
      k. Watts Water Technologies, Inc.; Watts Regulator Co.

   2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.
   3. Body: Dezincification resistant brass, or bronze.
   4. Minimum Flow Rate: 0.3 gpm.
   5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Calibrated Balancing Valves NPS 3/4 to NPS 2:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Armstrong Pumps, Inc.
   c. Apollo Valves; by Conbraco Industries, Inc.
   d. Bell & Gossett; Xylem Inc.
   e. Flo Fab Inc.
   f. Flow Design Inc.
   g. Griswold Controls.
   h. NIBCO INC.
   i. IMI Indoor Climate; Tour & Andersson.
   j. Taco, Inc.
   k. Watts Water Technologies, Inc.; Watts Regulator Co.

2. Type: Ball or Y-pattern globe valve with two readout ports and memory setting indicator.

3. Body: Dezincification resistant brass, or bronze.

4. Size: Same as connected piping, but not larger than NPS 2.

5. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Acorn Controls; Morris Group International; ST70.
   b. Apollo Valves; Conbraco Industries, Inc.; Model MVD (34D Series).
   c. Bradley Corporation.
   d. Lawler Manufacturing Company, Inc.
   e. Leonard Valve Company; Series 170-LF and 270-LF.
   f. Watts Water Technologies, Inc.; Powers Division; Hydroguard Series LFe480, LFG480, and LFLM495.
   g. Watts Water Technologies, Inc.; Watts Regulator Co.
   h. Zurn Plumbing Products Group; Wilkins Div.


4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
8. Outlet Temperature Range: Adjustable from 85 deg F to 120 deg F. Set at 105 deg F.
9. Minimum Flow Rate: 0.5 gpm.
10. Valve Finish: Chrome plated.

B. Primary, Thermostatic, Water Mixing Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Acorn Controls; Morris Group International; MV17.
   b. Apollo Valves; Conbraco Industries, Inc.
   d. Bradley Corporation.
   e. Lawler Manufacturing Company, Inc.
   f. Leonard Valve Company.
   g. Symmons Industries, Inc.
   h. Watts Water Technologies, Inc.; Powers Division.
   i. Watts Water Technologies, Inc.; Watts Regulator Co.
   j. Zurn Plumbing Products Group; Wilkins Div.

3. Type: Exposed-mounting, thermostatically controlled water mixing valve.
5. Connections: Threaded union inlets and outlet.
6. Accessories: Manual temperature control, check stops and strainers on hot- and cold-water supplies, and adjustable, temperature-control handle.
7. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
8. Size, Settings, and Capacities: As scheduled on the drawings.

2.5 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
1. Manufacturers:
   a. Apollo Valves; Conbraco Industries, Inc.
   b. Keckley.
   c. Metraflex.
   d. Mueller Steam Specialty.
   e. NIBCO, Inc.
   f. Spence.
   g. SSI Equipment, Inc.
   h. Watts Water Technologies, Inc.
   i. Yarway.

2. CWP: 200 psig minimum, unless otherwise indicated.
3. SWP: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 and larger.
5. End Connections: Threaded or soldered for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
6. Screen: Stainless steel with round perforations, unless otherwise indicated.
7. Perforation Size:
   a. Strainers NPS 2 and Smaller: 0.033 inch.
   b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.


2.6 HOSE BIBBS

A. Hose Bibbs:
   4. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
   5. Outlet Connection: Garden-hose thread complying with ASME B1.20.7.
   8. Finish for Equipment Rooms: Chrome or nickel plated.
   9. Finish for Service Areas: Chrome or nickel plated.
   10. Finish for Finished Rooms: Chrome or nickel plated.
11. Operation for Equipment Rooms: Wheel handle or operating key.
12. Operation for Service Areas: Operating key.
14. Include operating key with each operating-key hose bibb.
15. Include integral wall flange with each chrome- or nickel-plated hose bibb.

2.7 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Water Technologies, Inc.; Watts Regulator Co.
   f. Woodford Manufacturing Company.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.

4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1.
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
9. Box and Cover Finish: Polished nickel bronze or chrome plated.
12. Operating Keys(s): Two with each wall hydrant.
2.8 WATER HAMMER ARRESTERS

A. Water Hammer Arresters (Copper Tube Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. MIFAB, Inc.
   b. PPP Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.

3. Type: Copper tube with piston.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

B. Water Hammer Arresters (Metal Bellows Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AMTROL, Inc.
   b. Josam Company.
   c. MIFAB, Inc.
   e. Tyler Pipe; Wade Div.
   f. Watts Drainage Products Inc.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.

3. Type: Precharged stainless steel bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

C. Water Hammer Arresters (Custom Type):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. AMTROL, Inc.
b. Josam Company.
d. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Type: Factory precharged stainless steel pressure chamber with stainless steel bellows and non-toxic hydraulic fluid having pressure gage and air valve with cap.

3. Size: Custom sized for application by manufacturer.

2.9 AIR VENTS

A. Bolted-Construction Automatic Air Vents:

1. Body: Bronze.
2. Pressure Rating: 125-psig minimum pressure rating at 140 deg F.
3. Float: Replaceable, corrosion-resistant metal.

B. Welded-Construction Automatic Air Vents:

2. Pressure Rating: 150-psig minimum pressure rating.
3. Float: Replaceable, corrosion-resistant metal.

2.10 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. MIFAB, Inc.
   b. PPP Inc.
   c. Sioux Chief Manufacturing Company, Inc.
5. Inlet and Outlet Connections: NPS 1/2 threaded, union, or solder joint.
6. Gravity Drain Outlet Connection: NPS 1/2 threaded or solder joint.
7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

B. Drainage-Type, Trap-Seal Primer Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. PPP Inc.; Tail Piece Trap Priming Assembly.
b. MIFAB, Inc.

2. Standard: ASSE 1044, lavatory P-trap with NPS 1/2 minimum, trap makeup connection.

C. Electronic-Type, Trap-Seal Primer:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. PPP Inc.; Solo-Prime.

2. Standard: ASSE 1044.
3. Body Material: NPS 1, ASTM B 88, Type K; copper, water tubing.
4. Electric Controls: Sub-miniature solenoid valve, designed to interface with low-voltage energy management systems.
6. Inlet Size: NPS 1/2.
7. Outlet Size: NPS 1/2, threaded.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
   3. Do not install bypass piping around backflow preventers.

C. Install balancing valves in locations where they can easily be adjusted.

D. Install temperature-actuated water mixing valves with strainers, and check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install thermometers and water regulators if specified.

E. Install water hammer arresters in water piping according to PDI-WH 201.

F. Install air vents at high points of water piping. Install drain piping and discharge onto floor drain.

G. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of
1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

H. Install drainage-type, trap-seal primer valves as lavatory trap with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting.

I. Install trap-seal primer systems with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust system for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 16 Section "Grounding and Bonding."

C. Connect wiring according to Division 16 Section "Conductors and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
5. Primary, thermostatic, water mixing valves.
7. Trap-seal primer systems.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 15 Section "Mechanical Identification."
3.4 FIELD QUALITY CONTROL
A. Perform the following tests and prepare test reports:
   1. Test each backflow prevention device according to authorities having jurisdiction and the device's reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.5 ADJUSTING
A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves as follows:
   1. Set calibrated balancing valves at calculated presettings.
   2. Measure flow at all stations and adjust where necessary.
   3. Record settings and mark balancing devices.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION 15145
SECTION 15150 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 02 Section “Sanitary Sewage” for piping outside building.
2. Division 15 Section “Mechanical General Requirements”.
3. Division 15 Section “Basic Mechanical Materials and Methods”.
4. Division 15 Section “Drainage Piping Specialties”.

1.2 DEFINITIONS

B. EPDM: Ethylene-propylene-diene terpolymer rubber.
C. LLDPE: Linear, low-density polyethylene plastic.
D. NBR: Acrylonitrile-butadiene rubber.
E. PE: Polyethylene plastic.
F. PVC: Polyvinyl chloride plastic.
G. TPE: Thermoplastic elastomer.

1.3 SYSTEMS DESCRIPTIONS
A. Sanitary waste and vent piping system materials are scheduled on the Drawing.

1.4 SUBMITTALS
A. Product Data: For pipe, tube, fittings, and couplings.
B. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).
C. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.

B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. CISPI, Hubless-Piping Couplings:

1. Manufacturers:
   a. ANACO-Husky; McWane Plumbing Group.
   b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
   c. IDEAL-TRIDON.
   d. Mission Rubber Company; a division of MCP Industries, Inc.
   e. Tyler Pipe; McWane Plumbing Group.

3. Description: NSF certified for compliance with CISPI 310. Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers:
   a. ANACO-Husky; McWane Plumbing Group; SD 4000.
   b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
   c. IDEAL-TRIDON; Heavy-Duty “HD” No-Hub Couplings.
   d. Norma Group; Clamp-All Products; HI-TORQ 125.

2. Standards: ASTM C 1277 and ASTM C 1540, or ASTM C 1277 and FM 1680 Class I.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
2.4 SPECIALTY PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   b. Fernco, Inc.
   c. Logan Clay Products Company (The).
   d. Mission Rubber Co.
   e. NDS, Inc.
   f. Plastic Oddities, Inc.

2. Sleeve Materials:
   b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   b. Mission Rubber Co.

C. Rigid, Unshielded, Nonpressure Pipe Couplings: ASTM C 1461, sleeve-type reducing- or transition-type mechanical coupling molded from ASTM C 1440, TPE material with corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   a. ANACO.
D. Pressure Pipe Couplings: AWWA C219 metal, sleeve-type same size as, with pressure rating at least equal to, and ends compatible with, pipes to be joined.

1. Manufacturers:
   b. Dresser, Inc.; DMD Div.
   c. Ford Meter Box Company, Inc. (The); Pipe Products Div.
   d. JCM Industries, Inc.
   e. Smith-Blair, Inc.
   f. Viking Johnson.

2. Center-Sleeve Material: Manufacturer's standard.
3. Gasket Material: Natural or synthetic rubber.
4. Metal Component Finish: Corrosion-resistant coating or material.

E. Wall-Penetration Fittings: Compound, ductile-iron coupling fitting with sleeve and flexing sections for up to 20-degree deflection, gaskets, and restrained-joint ends complying with AWWA C110 or AWWA C153. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.

1. Manufacturers:
   a. SIGMA Corp.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Comply with requirements in Division 02 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING SYSTEM INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
B. Sanitary sewer piping outside the building is specified in Division 02 Section "Sanitary Sewerage."

C. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

D. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

E. Install cleanout fitting with closure plug inside the building in sanitary force-main piping.

F. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 15 Section "Basic Mechanical Materials and Methods."


H. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
J. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:

1. Building Sanitary Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
2. Horizontal Sanitary Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
3. Vent Piping: 1/8-inch per foot down toward vertical fixture vent or toward vent stack.

K. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

L. Install PVC soil and waste drainage and vent piping according to ASTM D 2665.

M. Install underground PVC soil and waste drainage piping according to ASTM D 2321.

N. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."


C. Join hub-and-spigot, cast-iron soil piping with caulked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum caulked joints.

D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

E. Join stainless-steel pipe and fittings with gaskets according to ASME A112.3.1.

F. PVC Nonpressure Piping Joints: Join piping according to ASTM D 2665.
3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.


4. In Underground Force Main Piping:
   a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
   b. NPS 2 and Larger: Pressure transition couplings.

3.5 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.

2. Install individual, straight, horizontal piping runs according to the following:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.

4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.
E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 15 Section "Mechanical Identification."

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be
made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must
remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.

2. Cap and subject piping to static-water pressure of 150 psig, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.

3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

4. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 15150
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

   1. Division 15 Section “Mechanical General Requirements.”
   2. Division 15 Section “Basic Mechanical Materials and Methods.”
   3. Division 15 Section "Plumbing Fixtures" for hair interceptors.

1.2 DEFINITIONS


B. FRP: Fiberglass-reinforced plastic.
C. HDPE: High-density polyethylene plastic.
D. PE: Polyethylene plastic.
E. PP: Polypropylene plastic.
F. PVC: Polyvinyl chloride plastic.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.
B. Operation and Maintenance Data: For drainage piping specialties to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE
A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
C. Comply with ASPE/ANSI 45-2013 “Siphonic Roof Drainage” for siphonic roof drainage systems.

1.5 COORDINATION
A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
B. Coordinate size and location of roof penetrations.

PART 2 - PRODUCTS
2.1 CAST-IRON CLEANOUTS
A. Size: Cleanouts shall be same nominal size as the pipe they serve up to 4 inches. For pipes larger than 4 inches nominal size, minimum size of cleanout shall be 4 inches.
B. Exposed Cast-Iron Cleanouts:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
b. MIFAB, Inc.; C1460.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.

3. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.

4. Closure: Countersunk or raised-head, brass or bronze plug with tapered threads.

C. Cast-Iron Floor Cleanouts (On-Grade Interior Floor Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
b. MIFAB, Inc.; C1220-R.
c. Sioux Chief Manufacturing Company, Inc.
e. Tyler Pipe; Wade Div.
f. Watts Drainage Products Inc.
g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M.

3. Type: Adjustable housing.

4. Body or Ferrule: Cast iron.

5. Clamping Device: Not required.


7. Closure: Brass, bronze, or plastic plug with tapered threads.

8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.
9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.

10. Frame and Cover Shape: Round.

11. Top Loading Classification: Medium Duty.

12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

D. Cast-Iron Floor Cleanouts (Not-On-Grade Interior Floor Areas):

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. MIFAB, Inc.; C-1100-C-R-34.
   c. Sioux Chief Manufacturing Company, Inc.
   e. Tyler Pipe; Wade Div.
   f. Watts Drainage Products Inc.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M.

3. Type: Adjustable housing.

4. Body or Ferrule: Cast iron.

5. Clamping Device: Required.


7. Closure: Brass, bronze, or plastic plug with tapered threads.

8. Adjustable Housing Material: Cast iron with threads, set-screws or other device.

9. Frame and Cover Material and Finish: Nickel-bronze, copper alloy with scoriated cover in service areas, and recessed cover to accept floor finish material in finished floor areas.

10. Frame and Cover Shape: Round.

11. Top Loading Classification: Medium Duty.

12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.

E. Cast-Iron Wall Cleanouts (Finished Wall Areas):
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. MIFAB, Inc.; C1460-RD.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M. Include wall access.
3. Body: Hub-and-spigot, cast-iron soil pipe T-branch or hubless, cast-iron soil pipe test tee as required to match connected piping.
4. Closure: Countersunk or raised-head, drilled-and-threaded bronze or brass plug with tapered threads.

2.2 FLOOR DRAINS

A. Cast-Iron Floor Drains (Toilet Rooms, Labs, and Janitor’s Closet) FD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. MIFAB, Inc.
   e. Tyler Pipe; Wade Div.
   f. Watts Drainage Products Inc.
   g. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
5. Seepage Flange: Required.
7. Outlet: Bottom unless otherwise noted.
11. Top Shape: Round, with vandal proof screws.
12. Dimensions of Top or Strainer: 7 inch diameter.

B. Cast-Iron Floor Drains (Mechanical Rooms, Electrical Rooms, and Penthouses) FD-2:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
5. Seepage Flange: Required.
7. Outlet: Bottom unless otherwise noted.
10. Top or Strainer Material: Cast-iron.
11. Top Shape: Round.
12. Dimensions of Top or Strainer: 11-1/2 inch diameter tractor grate, 29 square inches of free area.
14. Outlet Fitting: Gray iron, with spigot outlet.

C. Cast-Iron Floor Sink Drains FS-1:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
b. MIFAB, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.3.
5. Seepage Flange: Required.
7. Outlet: Bottom.
10. Top of Body and Strainer Finish: Gray iron.
11. Top Shape: Square.
12. Dimensions of Top or Strainer: 10 inch by 10 inch, having 28 square inches of free area, and with flat bottom strainer.
14. Outlet Connection: Gray iron, with spigot outlet.

2.3 ROOF FLASHING ASSEMBLIES

A. Roof Flashing Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. Acorn Engineering Company; Elmdor/Stoneman Div.
b. Thaler Metal Industries Ltd.

B. Description: Manufactured assembly consisting of metal flashing collar and skirt extending at least 10 inches from pipe, with boot reinforcement and counterflashing fitting.


2.4 TRAP SEAL PROTECTION DEVICES

A. Barrier Type Trap Seal Protection Devices:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Smith, Jay R. Mfg. Co.; Quad Close Trap Seal Device Fig. 2692.
   b. Rectorseal; a CSW Industrials Company; SureSeal Plus Inline Floor Drain Trap Sealer.

3. Sealing Element: Neoprene rubber or chemically resistant elastomer.
4. Size: 2 inch, 3 inch, 3-1/2 inch, or 4 inch.
5. Gravity Drain Outlet Connection: Compression fit sealing gasket 80 durometer.

2.5 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. ProSet Systems Inc.

2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
6. Special Coating: Corrosion resistant on interior of fittings.
2.6 ROOF DRAINS

A. Metal Roof Drains RD-1:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. MIFAB, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.6.4
3. Pattern: Roof drain.
5. Dimensions of Body: Minimum 10 inch diameter body.
6. Combination Flashing Ring and Gravel Stop: Required.
8. Outlet: Bottom unless otherwise noted.
9. Dome Material: Cast iron, or ductile iron.
11. Underdeck Clamp: Required.
13. Standpipe: 2 inches high where overflow drains are indicated.

2.7 MISCELLANEOUS DRAINAGE PIPING SPECIALTIES

A. Deep-Seal Traps:

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
   a. NPS 2: 4-inch- minimum water seal.
   b. NPS 2-1/2 and Larger: 5-inch- minimum water seal.

B. Sleeve Flashing Device:

1. Description: Manufactured, cast-iron fitting, with clamping device, that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-
steel pipe extension in top of fitting that will extend 2 inches above finished floor and galvanized-
steel pipe extension in bottom of fitting that will extend through floor slab.
2. Size: As required for close fit to riser or stack piping.

C. Stack Flashing Fittings:
   1. Description: Counterflushing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
   2. Size: Same as connected stack vent or vent stack.

D. Expansion Joints:
   1. Standard: ASME A112.21.2M.
   2. Body: Cast iron with bronze sleeve, packing, and gland.
   3. End Connections: Matching connected piping.
   4. Size: Same as connected soil, waste, or vent piping.

E. Downspout Nozzles DNZ-1:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.; Model 1770-NB-BS.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.; RD-940-83.
      f. Zurn Plumbing Products Group; Specification Drainage Operation.
   2. Description: Bronze body with threaded inlet, bronze wall flange with mounting holes, and bird screen.
   3. Size: Same as connected conductor.

2.8 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Applications: 12 oz./sq. ft..
   2. Vent Pipe Flashing: 8 oz./sq. ft..

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.


E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.

2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.

4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.

1. Position floor drains for easy access and maintenance.

2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:

   a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.

   b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.

   c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.

3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.

4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
H. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions. Roofing materials are specified in Division 07.

1. Install roof-drain flashing collar or flange so that there will be no leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Position roof drains for easy access and maintenance.

I. Assemble open drain fittings and install with top of hub 2 inches above floor.

J. Install deep-seal traps on floor drains and other waste outlets, if indicated.

K. Install floor-drain, trap-seal primer fittings on floor drains that require trap-seal primer connection.

L. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

M. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

N. Install downspout nozzles at exposed bottom of conductors where they spill onto grade.

O. Install wood-blocking reinforcement for wall-mounting-type specialties.

P. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

Q. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.
3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION 15155
SECTION 15160 - STORM DRAINAGE PIPING

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 02 Section “Storm Drainage” for piping outside building.
2. Division 15 Section “Mechanical General Requirements.”
3. Division 15 Section “Basic Mechanical Materials and Methods.”
4. Division 15 Section “Drainage Piping Specialties.”
5. Division 15 Section "Sump Pumps."

1.2 DEFINITIONS

1.3 SYSTEMS DESCRIPTIONS
A. Storm drainage piping system materials are scheduled on the Drawing.

1.4 SUBMITTALS
A. Product Data: For pipe, tube, fittings, and couplings.
B. Shop Drawings:
C. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE
A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Cast-iron soil pipe shall be marked with the collective trademark of Cast Iron Soil Pipe Institute (CISPI).
D. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be as recommended by the manufacturer of the grooved components.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class.
B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.
B. CISPI, Hubless-Piping Couplings:

1. Manufacturers:
   a. ANACO-Husky; McWane Plumbing Group.
   b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
   c. IDEAL-TRIDON.
   d. Mission Rubber Company; a division of MCP Industries, Inc.
   e. Tyler Pipe; McWane Plumbing Group.

3. Description: NSF certified for compliance with CISPI 310. Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

C. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers:
   a. ANACO-Husky; McWane Plumbing Group; SD 4000.
   b. Ferguson Enterprises, Inc.; ProFlo (Private labeled IDEAL-TRIDON).
   c. IDEAL-TRIDON; Heavy-Duty “HD” No-Hub Couplings.
d. Norma Group; Clamp-All Products; HI-TORQ 125.

2. Standards: ASTM C 1277 and ASTM C 1540, or ASTM C 1277 and FM 1680 Class I.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 SPECIAL PIPE FITTINGS

A. Flexible, Nonpressure Pipe Couplings: Comply with ASTM C 1173, elastomeric, sleeve-type, reducing or transition pattern. Include shear ring, ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   b. Fernco, Inc.
   c. Logan Clay Products Company (The).
   d. Mission Rubber Co.
   e. NDS, Inc.
   f. Plastic Oddities, Inc.

2. Sleeve Materials:
   b. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
   c. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.

B. Shielded Nonpressure Pipe Couplings: ASTM C 1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

1. Manufacturers:
   b. Mission Rubber Co.
PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 02 Section "Earthwork" for excavating, trenching, and backfilling.

3.2 PIPING SYSTEM INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 02 Section "Storm Drainage."

B. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers. Cleanouts are specified in Division 15 Section "Drainage Piping Specialties."

D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

F. Make changes in direction for storm piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Lay buried building drain piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

H. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
1. Building Storm Drain: 1/8-inch per foot downward in direction of flow, unless otherwise noted.
2. Horizontal Storm-Drainage Piping: 1/8-inch per foot downward in direction of flow, unless otherwise noted.

I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.3 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."


3.4 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 15 Section "Hangers and Supports." Install the following:

1. Vertical Piping: MSS Type 8 or Type 42, clamps.
2. Individual, Straight, Horizontal Piping Runs: According to the following:
   a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
   c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 15 Section "Hangers and Supports."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6: 60 inches with 3/4-inch rod.
   5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.
   6. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 84 inches with 3/8-inch rod.
   2. NPS 1-1/2: 108 inches with 3/8-inch rod.
   3. NPS 2: 10 feet with 3/8-inch rod.
   4. NPS 2-1/2: 11 feet with 1/2-inch rod.
   5. NPS 3: 12 feet with 1/2-inch rod.
   6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
   7. NPS 6: 12 feet with 3/4-inch rod.
   8. NPS 8 to NPS 12: 12 feet with 7/8-inch rod.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.
3.5 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.6 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.

2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Test Procedure: Test storm drainage piping on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.

4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

5. Prepare reports for tests and required corrective action.

3.7 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION 15160
SECTION 15181 - HYDRONIC PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 07 Section "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
2. Division 07 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
3. Division 15 Section “Mechanical General Requirements.”
4. Division 15 Section "Basic Mechanical Materials and Methods" for general piping materials and installation requirements.
5. Division 15 Section "Hangers and Supports" for pipe supports, product descriptions, and installation requirements. Hanger and support spacing is specified in this Section.
6. Division 15 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”
7. Division 15 Section "Meters and Gages" for thermometers, flow meters, flow measuring devices, and pressure gages.
8. Division 15 Section "Mechanical Identification" for labeling and identifying hydronic piping.
9. Division 15 Section "General-Duty Valves for HVAC" for general-duty gate, globe, ball, butterfly, and check valves.
10. Division 15 Section "Hydronic Pumps" for pumps, motors, and accessories for hydronic piping.
11. Division 15 Section "Temperature Controls" for temperature-control valves and sensors.
12. Division 15 Section “Piping Systems Flushing and Chemical Cleaning.”
13. Division 15 Section “HVAC Water Treatment.”

1.2 DEFINITIONS

A. CPVC: Chlorinated polyvinyl chloride.
B. HDPE: High density polyethylene.
C. PP: Polypropylene.
D. PVC: Polyvinyl chloride.
E. PTFE: Polytetrafluoroethylene.
F. RTRF: Reinforced thermosetting resin (fiberglass) fittings.
G. RTRP: Reinforced thermosetting resin (fiberglass) pipe.
1.3 PERFORMANCE REQUIREMENTS

A. Where not indicated on the Drawings, hydronic piping components and installation shall be capable of withstanding the following minimum working pressures and temperatures:

1.4 SYSTEMS DESCRIPTIONS

A. Hydronic piping system materials are scheduled on the Drawings.

B. Refer to Application Schedule on the Drawings for valve types to be used. Where specific valve types are not indicated, the following requirements apply:

2. Drain Duty: Hose-end drain valves.

1.5 SUBMITTALS

A. Product Data: For each type of the following:

1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air control devices.
4. Hydronic specialties.

B. Shop Drawings: Detail, at minimum ¼ scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Qualification Data: For Installer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in operation and maintenance manuals.
F. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.6 QUALITY ASSURANCE

A. ASME Compliance: Comply with ASME B31.9, "Building Services Piping" for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

B. Installer Qualifications:

1. Installers of Pressure-Sealed Joints: Installers shall be certified by pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

1.7 EXTRA MATERIALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Socket Fittings: ASME B16.22.

E. Wrought-Copper Unions: ASME B16.22.

F. Copper or Bronze Pressure-Seal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
a. Apollo Valves; by Conbraco Industries; ApolloXpress.
b. Elkhart Products Corporation; an Aalberts Industries Company; Xpress.
c. NIBCO Inc.; Press System.
d. Viega North America; ProPress System.

2. Housing: Copper.
3. O-Rings and Pipe Stops: EPDM.
4. Tools: Manufacturer's special tools.
5. Minimum 200-psig working-pressure rating at 250 deg F.

G. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube. Mechanically formed tee fittings may be used up to half size of main.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. T-DRILL Industries Inc.

2.2 STEEL PIPE AND FITTINGS

A. Schedule 40 Steel Pipe: ASTM A 53/A 53M or ASTM A 106, Type E or S, Grade A or B. Include ends matching joining method.

7. Flanges: Class 300 forged steel welding neck to match pipe wall thickness and valve flanges, ANSI B16.5. Orifice plate flanges shall be raised face welding neck type with ring joint gaskets and flange taps. Coordinate orifice plate flanges with orifice plate flow elements.
2.3 JOINING MATERIALS

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods.”

2.4 TRANSITION FITTINGS

A. HDPE Plastic-to-Grooved Steel Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International, Inc.; Gruvlok Manufacturing; Fig. 7307.
   b. Victaulic Company; Style 997.

2. Ductile iron coupling with integral rows of gripping teeth on the HDPE side of the coupling and conventional key section on grooved side designed to engage standard roll or cut grooved steel pipe.

B. HDPE Plastic-to-Metal Transition Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Anvil International, Inc.; Gruvlok Manufacturing; Fig. 7312.
   b. Victaulic Company; Style 994 Vic-Flange.

2. Ductile iron flange adapter having integral gasket and designed to permit direct connection of ANSI Class 125 and 150 steel or bronze flanged components into HDPE systems.

2.5 VALVES

A. General Service Valves: Comply with requirements specified in Division 15 Section "General-Duty Valves for HVAC."

2.6 SPECIALTY VALVES

A. Balance Valves:

1. Balance Valves NPS 6 and Larger: Lug type butterfly valves with aluminum bronze disc, AISI 300 Series
stainless steel stem, resilient replaceable seat for service at not less than 250 deg F and memory stops. Refer to Division 15 Section “General-Duty Valves for HVAC” for additional requirements.

a. Provide lubricated enclosed screw or worm gear operator with handwheel for sizes 6 inches and larger.
b. Pressure rating shall meet or exceed system minimum pressure rating.


3. Balance Valves for Sizes Less than NPS 6 Combination balance valve and flow measuring device as specified in this Section.

B. Combination, Balancing Valves and Flow Measuring Devices NPS 2 and Smaller:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Griswold Controls.
   b. Hydronic Components, Inc. (HCi).
   c. IMI Flow Design; IMI Hydronic Engineering Inc.
   d. Nexus Valve.
   e. PRO Hydronic Specialties, LLC.

2. Manufacturers: Subject to compliance with requirements, use products by one of the following:

   a. Tour & Andersson; TA Hydronics Series available through Victaulic Company of America.
   b. Tyco Fire & Building Products, Grinnell Mechanical Products (formerly marketed by Mepco).

3. Body: Brass or bronze, ball or plug type with calibrated orifice or venturi.
4. Ball: Plated brass, or stainless steel.
5. Plug: Resin.
6. Seat: PTFE.
7. End Connections: Threaded or socket.
9. Handle Style: Lever, with memory stop to retain set position.
10. WOG Rating: Minimum 400 psig.
11. Maximum Operating Temperature: 250 deg F.

2.7 CONTROL VALVES

A. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 15 Section "Temperature Controls."

B. Calibrated orifice balancing valves shall not be required on devices where pressure independent characterized control valves (PICCV’s) are installed.

2.8 AIR CONTROL DEVICES

A. Manual Air Vents: Use ball-valve-type hose-end drain valves, refer to Division 15 Section "General-Duty Valves for HVAC."

B. Automatic Air Vents:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett; Xylem Inc.
   d. Spirotherm, Inc.
   e. Taco, Inc.

2. Body: Bronze or cast iron.
3. Internal Parts: Nonferrous.
5. Inlet Connection: NPS 1/2.
8. Maximum Operating Temperature: 240 deg F.

C. Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Amtrol, Inc.
b. Armstrong Pumps, Inc.
c. Bell & Gossett; Xylem Inc.
d. Taco, Inc.
e. Wessels Co.

2. Tank: Welded steel, rated for 125-psig working pressure and 375 deg F maximum operating temperature, with taps in bottom of tank for tank fitting and taps in end of tank for gage glass. Tanks shall be factory tested with taps fabricated and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

3. Air-Control Tank Fitting: Cast-iron body, copper-plated tube, brass vent tube plug, and stainless-steel ball check, 100-gal. unit only; sized for compression-tank diameter. Provide tank fittings for 125-psig working pressure and 250 deg F maximum operating temperature.

4. Tank Drain Fitting: Brass body, nonferrous internal parts; 125-psig working pressure and 240 deg F maximum operating temperature; constructed to admit air to compression tank, drain water, and close off system.


D. Bladder-Type Expansion Tanks:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Amtrol, Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett; Xylem Inc.
   d. Taco, Inc.
   e. Wessels Co.

2. Tank: Welded steel, rated for 125-psig working pressure and 240 deg F maximum operating temperature. Factory test with taps fabricated and supports installed and labeled according to ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
3. Bladder: Securely sealed into tank to separate air charge from system water to maintain required expansion capacity.


E. Combination Air and Dirt Separators:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   
a. Spirotherm, Inc.; VDN Series.

2. Body: Fabricated steel; constructed for 150-psig maximum working pressure and 250 deg F maximum operating temperature. Separator shall have body extended below pipe connections for dirt separation and include removable lower head.

3. Air and Dirt Separation Mechanism: Internal copper core tube with continuous wound copper medium permanently attached followed by continuous wound copper wire permanently affixed.

4. Venting Chamber: With integral full port, float actuated brass venting mechanism. Include valved side tap to flush floating dirt or liquids and for quick bleeding of air during system fill.

5. Inlet and Outlet Connections: Threaded for NPS 2 and smaller; flanged connections for NPS 2-1/2 and larger.


7. Size: Match system flow capacity.

2.9 HYDRONIC PIPING SPECIALTIES

A. Diverting Fittings: 125-psig working pressure; 250 deg F maximum operating temperature; cast-iron body with threaded ends, or wrought copper with soldered ends. Indicate flow direction on fitting.

B. Flexible connectors and expansion fittings are specified in Division 15 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."

2.10 HYDRONIC PIPING STRAINERS

A. Manufacturers:
1. Keckley.
2. Metraflex.
4. Nibco, Inc.
5. Spence.
6. Sure Flow Equipment Inc.
7. Watts Water Technologies, Inc.
8. Yarway.
10. Tyco Fire & Building Products, Grinnell Mechanical Products (for grooved piping).
11. Victaulic Company; (for grooved piping).

B. Y-Pattern Strainers, Bronze:

1. CWP: 200 psig minimum, unless otherwise indicated.
2. SWP: 125 psig minimum, unless otherwise indicated.
4. End Connections: Threaded or soldered.
5. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
6. Drain:
   a. Pipe plug for sizes NPS 2 and smaller.
   b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.

C. Y-Pattern Strainers, Cast and Ductile Iron:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP: 200 psig minimum, unless otherwise indicated.
5. SWP: 125 psig minimum, unless otherwise indicated.
6. Drain:
   a. Pipe plug for sizes NPS 2 and smaller.
   b. Factory-installed, hose-end drain valve for sizes NPS 2-1/2 and larger.
PART 3 - EXECUTION

3.1 PIPING SYSTEMS INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. 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, other than drain 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 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 Division 15 Section "General-Duty Valves for HVAC."

Q. Install shutoff duty valves at each branch connection to supply mains, at supply connection to each piece of equipment, unless only one piece of equipment is connected in the branch line. Install throttling duty valves at each branch connection to return mains, at return connections to each piece of equipment, and elsewhere as indicated.

R. Install pressure independent control valves in the return water line of each heating or cooling element and elsewhere as required to facilitate system balancing.

S. Install check valves at each pump discharge and elsewhere as required to control flow direction.

T. Install safety valves on hot-water generators and elsewhere as required by the ASME Boiler and Pressure Vessel Code. Install safety-valve discharge piping, without valves, to floor. Comply with the ASME Boiler and Pressure Vessel Code, Section VIII, Division 1, for installation requirements.

U. Install pressure-reducing valves on hot-water generators and elsewhere as required to regulate system pressure.

V. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

W. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

X. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and where indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match
size of strainer blowoff connection for strainers smaller than NPS 2.

Y. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 15 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."

Z. Identify piping as specified in Division 15 Section "Mechanical Identification."

3.2 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports." 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. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 11 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 12 feet; minimum rod size, 3/8 inch.
7. NPS 4: Maximum span, 14 feet; minimum rod size, 1/2 inch.
8. NPS 6: Maximum span, 17 feet; minimum rod size, 1/2 inch.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:

1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
7. NPS 4 to NPS 5: Maximum span, 10 feet minimum rod size, 1/2-inch.
8. NPS 6: Maximum span, 10 feet minimum rod size, 5/8-inch.

E. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.3 PIPE JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

3.4 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 automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

C. Install piping from boiler air outlet, air separator, or air purger to expansion tank with a 2 percent upward slope toward tank.
D. Install combination air/dirt separator in pump suction. Install blowdown piping with ball valve; extend full size to nearest floor drain.

E. Install bypass chemical feeders in each hydronic system where indicated, in upright position with top of funnel not more than 48 inches above the floor. Install feeder in minimum NPS 3/4 bypass line, from main with full-size, full-port, ball valve in the main between bypass connections. Install NPS 3/4 pipe from chemical feeder drain, to nearest equipment drain and include a full-size, full-port, ball valve.

F. Install expansion tanks as indicated in piping diagrams. 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.
3. Vent and purge air from hydronic system, and ensure tank is properly charged with air to suit system Project requirements.

3.5 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Division 15 Section "Meters and Gages."

3.6 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.

3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.

4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.

5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.

2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.

3. Isolate expansion tanks and determine that hydronic system is full of water.

4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 2 hours, 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. Remove disposal fine-mesh strainers in pump suction diffusers.
4. Set makeup pressure-reducing valves for required system pressure.
5. 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).
6. Set temperature controls so all coils are calling for full flow.
7. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
8. Verify lubrication of motors and bearings.

END OF SECTION 15181
SECTION 15183 - REFRIGERANT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 PERFORMANCE REQUIREMENTS

1.3 SYSTEMS DESCRIPTIONS

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3.3 VALVE AND SPECIALTY INSTALLATION

3.4 HANGERS AND SUPPORTS

3.5 FIELD QUALITY CONTROL

3.6 SYSTEM CHARGING

3.7 ADJUSTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 07 Section "Roof Accessories" for roof curbs, piping supports, and roof penetration boots.
2. Division 07 Section "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.
3. Division 07 Section "Joint Sealants" for materials and methods for sealing pipe penetrations through exterior walls.
4. Division 15 Section "Mechanical General Requirements.
5. Division 15 Section "Basic Mechanical Materials and Methods."
6. Division 15 Section "Hangers and Supports" for pipe supports and installation requirements.
7. Division 15 Section "Mechanical Identification" for labeling and identifying refrigerant piping.
8. Division 15 Section "Meters and Gages" for thermometers and pressure gages.
9. Division 15 Section "Temperature Controls" for thermostats, controllers, automatic-control valves, and sensors.

1.2 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant:

1.3 SYSTEMS DESCRIPTIONS

A. Suction Lines NPS 1-1/2 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed joints.

B. Suction Lines NPS 4 and Smaller for Conventional Air-Conditioning Applications: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

C. Hot-Gas and Liquid Lines NPS 1-1/2 and Smaller: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with brazed or soldered joints.

D. Hot-Gas and Liquid Lines NPS 4 and Smaller: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

E. Safety-Relief-Valve Discharge Piping: Copper, Type ACR, drawn-temper tubing and wrought-copper fittings with brazed joints.

1.4 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
1. Thermostatic expansion valves.
2. Solenoid valves.
3. Hot-gas bypass valves.
4. Filter dryers.
5. Strainers.
6. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.

1. Shop Drawing Scale: Minimum 1/4 inch equals 1 foot.
2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE


B. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

C. UL Standard: Provide products complying with UL 207, "Refrigerant-Containing Components and Accessories, Nonelectrical"; or UL 429, "Electrically Operated Valves."

1.6 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.
1.7 COORDINATION

A. Coordinate layout and installation of refrigerant piping and suspension system components with other construction, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate pipe sleeve installations for foundation wall penetrations.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

D. Coordinate pipe sleeve installations for penetrations in exterior walls and floor assemblies. Coordinate with requirements for firestopping specified in Division 07 Section "Through-Penetration Firestop Systems" for materials and methods for sealing pipe penetrations through fire and smoke barriers.

E. Coordinate pipe fitting pressure classes with products specified in related Sections.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

2.2 VALVES AND SPECIALTIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Climate & Industrial Controls Group; Parker-Hannifin Corp.; Refrigeration & Air Conditioning Division.
2. Danfoss Electronics, Inc.
3. Emerson Electric Company; Alco Controls Div.
5. Sporlan Valve Company.

B. Diaphragm Packless Valves:
1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
3. Operator: Rising stem and hand wheel.
5. End Connections: Socket, union, or flanged.
7. Maximum Operating Temperature: 275 deg F.

C. Packed-Angle Valves:
1. Body and Bonnet: Forged brass or cast bronze.
2. Packing: Molded stem, back seating, and replaceable under pressure.
3. Operator: Rising stem.
5. Seal Cap: Forged-brass or valox hex cap.
6. End Connections: Socket, union, threaded, or flanged.
8. Maximum Operating Temperature: 275 deg F.

D. Check Valves:
1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
6. End Connections: Socket, union, threaded, or flanged.
7. Maximum Opening Pressure: 0.50 psig.
9. Maximum Operating Temperature: 275 deg F.

E. Service Valves:
1. Body: Forged brass with brass cap including key end to remove core.
2. Core: Removable ball-type check valve with stainless-steel spring.
4. End Connections: Copper spring.
F. Solenoid Valves: Comply with AHRI 760 and UL 429; listed and labeled by an NRTL.
   4. End Connections: Threaded.
   5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 208-V ac coil.
   7. Maximum Operating Temperature: 240 deg F.

G. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
   1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
   4. End Connections: Threaded.
   6. Maximum Operating Temperature: 240 deg F.

H. Thermostatic Expansion Valves: Comply with AHRI 750.
   1. Body, Bonnet, and Seal Cap: Forged brass or steel.
   4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
   5. Suction Temperature: 40 deg F.
   7. Reverse-flow option (for heat-pump applications).
   8. End Connections: Socket, flare, or threaded union.

I. Straight-Type Strainers:
   2. Screen: 100-mesh stainless steel.
   3. End Connections: Socket or flare.
5. Maximum Operating Temperature: 275 deg F.

J. Angle-Type Strainers:

1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
6. Maximum Operating Temperature: 275 deg F.

K. Moisture/Liquid Indicators:

2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
3. Indicator: Color coded to show moisture content in ppm.
5. End Connections: Socket or flare.
7. Maximum Operating Temperature: 240 deg F.

L. Replaceable-Core Filter Dryers: Comply with AHRI 730.

1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
4. Designed for reverse flow (for heat-pump applications).
5. End Connections: Socket.
9. Maximum Operating Temperature: 240 deg F.

M. Mufflers:

2. End Connections: Socket or flare.
4. Maximum Operating Temperature: 275 deg F.
N. Receivers: Comply with AHRI 495.

1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
2. Comply with UL 207; listed and labeled by an NRTL.
4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
5. End Connections: Socket or threaded.
7. Maximum Operating Temperature: 275 deg F.

O. Liquid Accumulators: Comply with AHRI 495.

2. End Connections: Socket or threaded.
4. Maximum Operating Temperature: 275 deg F.

2.3 REFRIGERANTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Atofina Chemicals, Inc.
2. DuPont Company; Fluorochemicals Div.
3. Honeywell, Inc.; Genetron Refrigerants.
4. INEOS Fluor Americas LLC.

PART 3 - EXECUTION

3.1 PIPING SYSTEM INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. 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.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Refer to Division 15 Section "Temperature Controls" and Sequence of Operation on the Drawings for solenoid valve controllers, control wiring, and sequence of operation.

K. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

L. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and specialties in accessible locations to allow for service and inspection. Install access doors or panels as specified in Division 08 Section "Access Doors and Frames" if valves or equipment requiring maintenance is concealed behind finished surfaces.

M. Install refrigerant piping in protective conduit where installed belowground.

N. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

O. Slope refrigerant piping as follows:
   1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
   2. Install horizontal suction lines with a uniform slope downward to compressor.
   3. Install traps and double risers to entrain oil in vertical runs.
   4. Liquid lines may be installed level.
P. When brazing, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

Q. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

R. Seal penetrations through fire and smoke barriers according to Division 07 Section "Through-Penetration Firestop Systems."

S. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

T. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

U. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

V. Identify refrigerant piping and valves according to Division 15 Section "Mechanical Identification."

3.2 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube." Brazing filler metals are specified in Division 15 Section "Basic Mechanical Materials and Methods."

3.3 VALVE AND SPECIALTY INSTALLATION

A. Install packed-angle valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.
C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install packed-angle valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   1. Install valve so diaphragm case is warmer than bulb.
   2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
   1. Solenoid valves.
   2. Thermostatic expansion valves.
   3. Hot-gas bypass valves.
   4. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install receivers sized to accommodate pump-down charge.
3.4 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 15 Section "Hangers and Supports."

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
2. Roller hangers and spring hangers for individual horizontal runs 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. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:

1. NPS 3/4, and soft copper tubing: Continuous support v-shaped plastic pipe channel, maximum hanger spacing 8 feet.
2. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
3. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.

D. Support multifloor vertical runs at least at each floor.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:

1. Comply with ASME B31.5, Chapter VI.
2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
a. Fill system with nitrogen to the required test pressure.
b. System shall maintain test pressure at the manifold gage throughout duration of test.
c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.6 SYSTEM CHARGING

A. Charge system using the following procedures:

1. Install core in filter dryers after leak test but before evacuation.
2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.
3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.7 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:

1. Open shutoff valves in condenser water circuit.
2. Verify that compressor oil level is correct.
3. Open compressor suction and discharge valves.
4. Open refrigerant valves except bypass valves that are used for other purposes.
5. Check open compressor-motor alignment and verify lubrication for motors and bearings.
E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION 15183
1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”

2. Division 15 Section “Basic Mechanical Materials and Methods.”

1.2 DEFINITIONS

A. Buna-N: Nitrile rubber.

B. EPT: Ethylene propylene terpolymer.
1.3 SUBMITTALS

A. Product Data: Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.

B. Shop Drawings: Show pump layout and connections. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.


C. Operation and Maintenance Data: For all pumps and accessories to include in Operation and Maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hydronic pumps through one source from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Manufacturer's Preparation for Shipping: Clean flanges and exposed machined metal surfaces and treat with anticorrosion compound after assembly and testing. Protect flanges, pipe openings, and nozzles with wooden flange covers or with screwed-in plugs.

B. Store pumps in dry location.

C. Retain protective covers for flanges and protective coatings during storage.

D. Protect bearings and couplings against damage from sand, grit, and other foreign matter.
E. Comply with pump manufacturer's written rigging instructions.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 GENERAL PUMP REQUIREMENTS

A. Pump Units: Factory assembled and tested.

B. Motors: Comply with requirements in Division 15 Section "Motors".

C. Selection:

1. Base non-overloading characteristics for pumps upon nameplate horsepower, at any point on performance curve.
2. Shaft first critical speed shall not be less than 25 percent greater than operating speed.
3. Maximum impeller diameter shall not be greater than 90 percent of "cut water" diameter for a given casing and no smaller than the smallest published diameter for casing. Do not base acceptable maximum diameter calculation on percentage of impeller diameter range for a given casing.
4. Pump speed shall be limited to 1800 RPM except as scheduled.
5. Select at the point of maximum efficiency for a given impeller-casing combination. Deviations shall be within 3 percent of maximum efficiency on the increasing capacity side of the maximum efficiency point and 7 percent on the decreasing capacity side of the maximum efficiency point.
6. Select pump at a point no greater than 85 percent of end of curve flow.
7. Maximum pump suction velocity:
   a. In-line: 12 fps.
   b. End suction: 13 fps.
2.2 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.3 SMALL CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Manufacturers:

1. Armstrong Pumps Inc.
2. Bell & Gossett; Xylem Inc.; Series e-90.
4. Taco, Inc.

B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, and companion-flange connections.
2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.
3. Pump Shaft: Steel with copper-alloy shaft sleeve, or stainless steel.
4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N seal for all glycol systems and all water systems 225 deg F and below; EPT seals for water systems above 225 deg F. Include water slinger on shaft between motor and seal.

D. Motor: Single speed, with permanently or grease lubricated ball bearings, unless otherwise indicated; and
rigidly mounted to pump casing. Comply with requirements in Division 15 Section "Motors."

2.4 FLEXIBLY COUPLED, BASE-MOUNTED, END-SUCTION CENTRIFUGAL PUMPS

A. Manufacturers:

1. Armstrong Pumps Inc.; Series 4030.
2. Aurora Pump; Division of Pentair Pump Group; Series 3340.
3. Bell & Gossett; Xylem Inc.; Series e-1510.
4. Grundfos Pumps Corporation/PACO.
5. Taco, Inc.; Series FI.

B. Description: Factory-assembled and tested, centrifugal, overhung-impeller, separately coupled, end-suction pump as defined in HI 1.1-1.2 and HI 1.3; designed for base mounting, with pump and motor shafts horizontal. Rate pump for 175-psig minimum working pressure and a continuous water temperature of 225 deg F.

C. Pump Construction:

1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, drain plug at bottom and air vent at top of volute, and flanged connections. Provide integral mount on volute to support the casing, and attached piping to allow removal and replacement of impeller without disconnecting piping or requiring the realignment of pump and motor shaft true back pullout. Provide receptacle bronze wear rings for all pumps with pump shaft L/D ratios greater than 6.0.

2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. Trim impeller to match specified performance.

3. Pump Shaft: Steel, with copper-alloy shaft sleeve or stainless steel.

4. Mechanical Seal: Carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N seal for all glycol systems and all water systems 225 deg F and below; EPT seals for water systems above 225 deg F. Include water slinger on shaft between motor and seal.
5. Pump Bearings: Permanently or grease-lubricated ball bearings contained in cast-iron housing with grease fittings.

D. Flexible Shaft Coupling: Molded rubber insert and interlocking spider capable of absorbing vibration. Couplings shall be center drop-out type to allow disassembly and removal without removing pump shaft or motor. Provide EPDM coupling sleeve for all motors 40 HP and below and all variable-speed applications.

E. Coupling Guard: Dual rated; ANSI B15.1, Section 8; OSHA 1910.219 approved; steel; removable; attached to mounting frame.

F. Mounting Frame: Welded-steel frame and cross members, factory fabricated from ASTM A 36/A 36M channels and angles. Fabricate to mount pump casing, coupling guard, and motor.

G. Motor: Single speed, with permanently lubricated or grease-lubricated ball bearings, unless otherwise indicated; secured to mounting frame, with adjustable alignment. Comply with requirements in Division 15 Section "Motors".

H. Capacities and Characteristics: Refer to Schedule on Drawings.

2.5 PUMP SPECIALTY FITTINGS

A. Suction Diffuser: Angle pattern, minimum 175-psig pressure rating, cast-iron body and end cap for NPT or flanged connections or ductile iron body and end cap for grooved connections, pump-inlet fitting; with bronze startup and bronze or stainless-steel permanent strainers; bronze or stainless-steel straightening vanes; drain plug; and integral locating boss for field-fabricated support.

1. Manufacturers:
   a. Armstrong Pumps, Inc.
   b. Bell & Gossett; Xylem Inc.
   c. Grundfos Pumps Corporation/PACO.
   d. Mueller Steam Specialty Company.
   e. Taco; Fabricated Products Division.
   f. Anvil International, Inc. (grooved only).
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g. Victaulic Co. of America (grooved only).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.

C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.

D. Support in-line centrifugal pumps greater than 1/2 HP independent of piping. Use continuous-thread hanger rods and hangers of sufficient size to support pump weight. Do not support pump from motor housing plate.

E. Refer to Division 15 Section “Mechanical Vibration Controls” for vibration isolation devices.

F. Refer to Division 15 Section “Hangers and Supports” for hanger and support materials.

G. Set base-mounted pumps on concrete bases. Disconnect flexible coupling before setting. Do not reconnect flexible couplings until alignment procedure is complete.
1. Support pump baseplate on rectangular stainless steel blocks and shims, or on wedges with small taper, at points near foundation bolts to provide a gap of 3/4 to 1-1/2 inches between pump base and foundation for grouting.

2. Adjust metal supports or wedges until pump and driver shafts are level. Check coupling faces and suction and discharge flanges of pump to verify that they are level and plumb.

3. Install pumps on inertia bases where required. Refer to Division 15 Section “Mechanical Vibration Controls” for vibration isolation devices.

H. Automatic (Cooling Coil) Condensate Pump Units: Install units for collecting condensate and extend to open drain.

3.3 ALIGNMENT

A. Align pump and motor shafts and piping connections after setting on foundation, grout has been set and foundation bolts have been tightened, and piping connections have been made.

B. Comply with pump and coupling manufacturers' written instructions.

C. Adjust pump and motor shafts for angular and offset alignment by methods specified in HI 1.1-1.5, "Centrifugal Pumps for Nomenclature, Definitions, Application and Operation." Laser align to a tolerance of 0.0005 inches maximum.

D. After alignment is correct, tighten foundation bolts evenly but not too firmly.

E. 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.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.
C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.

D. Install check valve and throttling valve on discharge side of pumps. Triple-duty valves are not allowed.

E. Install suction diffuser and shutoff valve on suction side of pumps as indicated on drawings.

F. Install flexible connectors on suction and discharge sides of base-mounted pumps between pump casing and valves.

G. Install pressure gages on pump suction and discharge or at integral pressure-gage tappings, or install single gage with multiple-input selector valve.

H. Install check valve and gate or ball valve on each condensate pump unit discharge.

I. Install electrical connections for power, controls, and devices.

J. Ground equipment according to Division 16 Section "Grounding and Bonding."

K. Connect wiring according to Division 16 Section "Conductors and Cables."

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service for each pump supplied. Written report of the start-up shall be provided to the Owner and Engineer upon completion of services.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Perform the following startup checks for each pump before starting:
   a. Verify bearing lubrication.
   b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or
drags, do not operate until cause of trouble is determined and corrected.

c. Verify that pump is rotating in the correct direction.

5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Open discharge valve slowly.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.

END OF SECTION 15185
SECTION 15188 – PIPING SYSTEMS FLUSHING AND CHEMICAL CLEANING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

1.3 DEFINITIONS

1.4 PERFORMANCE REQUIREMENTS

1.5 SUBMITTALS

1.6 QUALITY ASSURANCE

1.7 COORDINATION

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 MATERIALS

PART 3 - EXECUTION

3.1 ACCEPTABLE SERVICE PROVIDER

3.2 PREPARATION

3.3 INITIAL FLUSHING

3.4 FLUSHING AND CHEMICAL CLEANING PROCEDURES

3.5 PLACING INTO OPERATION

3.6 FIELD QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”
3. Division 15 Section “Domestic Water Piping,” for disinfection of potable water piping.
4. Division 15 Section “Hydronic Piping.”
5. Division 15 Section “HVAC Water Treatment.”

1.2 SUMMARY

A. This Section includes chemical cleaning for the following piping systems:
1. Heating hot water.

1.3 DEFINITIONS

A. Cleaning: Recirculating water containing chemical cleaning and passivation compounds.

B. Flushing: Using approved water on a once through basis.

1.4 PERFORMANCE REQUIREMENTS

A. Furnish the services of a firm specializing in piping system chemical cleaning and water treatment work.

1. For chemical cleaning: This firm shall select the required type and quantity, based on system volume, of cleaning compound, and method of application.

1.5 SUBMITTALS

A. Product Data:

1. Proposed cleaning chemicals and quantities.
2. Proposed passivation chemicals and quantities.
3. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

B. Shop Drawings: Reduced scale plans indicating locations of velocity measurements.

C. Field quality-control test reports.

D. Other Informational Submittals:

2. Circulation pump suction and discharge pressure at start and completion of chemical cleaning operations.

1.6 QUALITY ASSURANCE

A. Service Provider Qualifications: An experienced piping systems cleaning service provider capable of applying cleaning compounds as specified in this Section.

B. Conduct safety meetings with Owner’s Representative and personnel involved in the cleaning process.
C. Assume responsibility for damage, necessary subsequent cleaning, flushing, and inspection of Work under the Contract which results from improper flushing and cleaning operations including failure to flush all dead-ends.

1.7 COORDINATION

A. Schedule flushing and chemical cleaning activities immediately after piping system pressure testing and immediately prior to piping system chemical treatment work to minimize internal oxidization or flash corrosion of piping systems.

B. Coordinate chemical cleaning work with other work to avoid accidental chemical discharge, spillage, or spray out, and electrolytically originated system damage resulting from concurrent chemical cleaning and arc welding.

C. Coordinate with work performed under other Sections to provide in-place temporary strainers, spool pieces, flushing hose connections, cross-over piping, and isolation and drain valves.

D. Chillers shall not be cleaned with any chloride component.

E. Boilers shall be flushed and cleaned to remove rust and oil deposits.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. System Cleaning Chemicals: Subject to compliance with requirements, provide products by one of the following:

1. PVS-Nolwood Chemicals, Inc.; PVS CHILL CLP Cleaner.
3. Mitco Custom Water Treatment.
5. GE Power & Water; Water & Process Technologies.

2.2 MATERIALS

A. Cleaning chemicals shall be as recommended by manufacturer and compatible with piping system components and connected equipment.
B. Provide additional temporary and permanent piping, equipment, and materials required for chemical cleaning work.

C. Use potable water for flushing and cleaning operations, unless directed otherwise by the Architect.

PART 3 - EXECUTION

3.1 ACCEPTABLE SERVICE PROVIDER

A. Subject to compliance with requirements, provide chemical cleaning service by one of the following:

1. GE Power & Water; Water & Process Technologies.
2. Mitco Custom Water Treatment.

3.2 PREPARATION

A. Prior to flushing and cleaning activities, drain the system of all water used for hydrostatic testing.

B. Temporarily connect dead-end supply and return piping as necessary to result in recirculating system in which no lines are left static for purposes of flushing and cleaning. Refer to System Piping Diagrams on the Drawings for suggested locations of temporary connections for flushing and cleaning purposes.

C. Select three locations for monitoring flow rates.

3.3 INITIAL FLUSHING

A. Remove loose dirt, mill scale, metal chips, weld beads, rust and other deleterious substances without damage to system components.

B. Bypass factory cleaned equipment, unless acceptable means of protection are provided and subsequent inspection of water boxes and other "hide-out" areas takes place.

C. Isolate or protect clean system components including pumps and pressure vessels and remove components which may be damaged.
D. Open valves, drains, vents and strainers at all system levels.

E. Remove plugs, caps, spool pieces and components to facilitate early discharge from system.

F. Sectionalize system if possible to obtain debris carrying velocity of 6 FPS.

G. Connect dead-end supply and return headers as necessary or provide terminal drains in end caps.

H. Install temporary strainers where necessary to protect down-stream equipment.

I. Supply and remove flushing water and drainage by fire hoses, garden hoses, temporary and permanent piping and Contractor's booster pumps.

J. Flush for not less than one hour.

K. Inspect system including basins to determine if debris accumulation requires dewatering and cleaning prior to next phase work.

3.4 FLUSHING AND CHEMICAL CLEANING PROCEDURES

A. Remove without chemical or mechanical damage to system components adherent dirt (organic soil), oil and grease (hydrocarbons), welding and soldering flux, mill varnish, pipe compounds, rust (iron oxide), and other deleterious substances not removed by initial flushing. Removal of tightly adherent mill scale is not required.

B. Fill system with fresh water and add manufacturer’s recommended volume of system cleaner to remove grease and petroleum products from piping. Circulate solution for 24 hours at a minimum velocity of 6 fps.

1. Utilize defoamers to preclude damage to existing work and adjacent electrical equipment.

2. Utilize heat to maximize effectiveness of compounds or use live steam injection where practical and safe. Do not raise cleaning water temperature in excess of controlled limits.
C. Monitor flow rates and clean strainers as required to maintain minimum specified velocity during the entire circulation and chemical cleaning period.

D. Cleaning of new piping systems shall be completed prior to connection of systems to existing services.

E. Install temporary strainer screens between pipe flange faces where necessary to protect primary system from branch connections during chemical cleaning procedures.

F. Following chemical cleaning:
   1. Remove, clean, and reinstall strainer baskets.
   2. Blow down and clean low points, dirt legs, and traps.

G. Drain systems:
   1. Check with local authorities concerning discharge requirements and submit copies of letters or reports.
   2. If acceptable, drain system to sanitary drainage system.
   3. Do not under any circumstances drain to storm drainage system or open drainage ditch.
   4. If discharge requirements do not allow discharge to sanitary sewer, secure the services of a licensed disposal Contractor.
   5. Disposal Contractors:
      a. Dynecol.
      b. SQS Environmental.

H. Perform final flush to remove any remaining debris and chemical from the system:
   1. Flush dead ends and isolated pre-cleaned equipment.
   2. Operate valves to dislodge debris in valve body.
   3. Flush for not less than 1 hour.

3.5 PLACING INTO OPERATION

A. Clean strainers.

B. Dewater and clean new sumps, basins, storage vessels and pressure vessels.
C. Disassemble, inspect, clean, repair, replace and reassemble any critical component or questionable item. Bellows style, and hose and braid flexible connectors left in place shall be removed and cleaned.

D. Preliminarily adjust control valves.

E. Install clean primary filter elements, if necessary, as determined by both pressure differential across filter and visual inspection of filter elements.

F. Close-up and fill system as soon as possible to minimize corrosion of untreated surfaces.

G. Vent air from system and adjust fill valve.

H. Immediately after completion of flushing and chemical cleaning, fill systems with potable water and make ready for chemical treatment as specified in Division 15 Section “HVAC Water Treatment.”

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Withdraw, inspect, and test samples of water from each system after flushing and chemical cleaning is completed, to ensure system is free of contaminants.

2. If loose debris or contaminants are still present, repeat final flushing procedures until test samples and strainers remain free of debris and contaminants.
SECTION 15189 - WATER TREATMENT FOR CLOSED-LOOP HYDRONIC SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”
3. Division 15 Section “Piping Systems Flushing and Chemical Cleaning.”

1.2 DEFINITIONS

A. CPVC: Chlorinated Polyvinyl Chloride.

B. EEPROM: Electrically erasable, programmable read-only memory.
C. EPDM: Ethylene-propylene-diene monomer.

D. 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.

E. RO: Reverse osmosis.

F. TDS: Total dissolved solids.

G. TSS: Total suspended solids are solid materials, including organic and inorganic, that are suspended in the water. These solids may include silt, plankton, and industrial wastes.

H. PTFE: Polytetrafluoroethylene.

I. UV: Ultraviolet.

1.3 PERFORMANCE REQUIREMENTS

A. Furnish the services of a firm specializing in hydronic piping system water treatment work.

B. Water quality for HVAC systems shall minimize corrosion, scale buildup, and biological growth for optimum efficiency of HVAC equipment without creating a hazard to operating personnel or the environment.

C. Base HVAC water treatment on quality of water available at Project site, HVAC system equipment material characteristics and functional performance characteristics, operating personnel capabilities, and requirements and guidelines of authorities having jurisdiction.

D. Base chemical quantities on estimated system size.

E. Closed hydronic systems, including hot-water heating with non-aluminum boilers, shall have the following water qualities:

1. pH: Maintain a value within 9.0 to 10.5.
2. "P" Alkalinity: Maintain a value within 100 to 500 ppm.
3. Boron: Maintain a value within 100 to 200 ppm.
4. Chemical Oxygen Demand: Maintain a maximum value of 100 ppm.
5. Soluble Copper: Maintain a maximum value of 0.20 ppm.
6. TDS: Maintain a maximum value of 5000 mmhos.
7. Free Caustic Alkalinity: Maintain a maximum value of 20 ppm.
8. Microbiological Limits:
   a. Total Aerobic Plate Count: Maintain a maximum value of 1000 organisms/ml.
   b. Total Anaerobic Plate Count: Maintain a maximum value of 100 organisms/ml.
   c. Ammonia: Maintain a maximum value of 20 ppm.
   d. Nitrate Reducers: Maintain a maximum value of 100 organisms/ml.
   e. Sulfate Reducers: Maintain a maximum value of 0 organisms/ml.
   f. Iron Bacteria: Maintain a maximum value of 0 organisms/ml.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for the following products:

1. Bypass feeders.
2. Water meters.
3. Inhibitor injection timers.
4. pH controllers.
5. Chemical test equipment.
6. Chemical material safety data sheets.

B. Shop Drawings: Pretreatment and chemical treatment equipment showing tanks, maintenance space required, and piping connections to HVAC systems. Include plans, elevations, sections, details, and attachments to other work.


C. Field quality-control test reports.

D. Other Informational Submittals:

1. Water-Treatment Program: Written sequence of operation on an annual basis for the application equipment.
required to achieve water quality defined in the "Performance Requirements" Article above.

2. An analytical review of make-up water characteristics for each treated system operating conditions, including such items as Langlier/Ryzner Indexes. Based on this review, provide a definitive description of treatment system developed to achieve specified objectives and include generic terms to describe product formulation content and function. Detailed proprietary formulation data is not required. However, manufacturer's standard published literature is not usually acceptable.

3. A step-by-step procedure to be followed by the Contractor during flushing, purging, disinfecting, draining, disposal, pretreatment and treatment operations. The intent of the step-by-step procedure is two-fold.

   a. To assure that all essential permanent provisions to accomplish the above work are included during the course of construction.

   b. To allow the Owner to accomplish the source procedures as subsequent maintenance operations.

E. Provide OSHA equivalent materials form for hazardous substances.

1.5 QUALITY ASSURANCE

A. HVAC Water-Treatment Service Provider Qualifications: An experienced HVAC water-treatment service provider capable of analyzing water qualities, installing water-treatment equipment, and applying water treatment as specified in this Section.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Conform to applicable codes for addition of non-potable chemicals to building mechanical systems, and for delivery to public sewage systems.
1.6 OWNER’S INSTRUCTIONS

A. Provide a coordinated water treatment training program oriented to the needs common to operating personnel and maintenance personnel and to the needs of maintenance personnel only, sufficiently prior to acceptance of the work, upon mutually satisfactory arrangement with the Architect.

B. Provide a total of not less than eight "field" hours encompassing mechanical, electrical, chemical, pollution and safety aspects, sufficient for personnel to operate and maintain systems and consistently achieve specified objectives, with subsequently scheduled guidance by the water treatment laboratory.

C. Water treatment laboratory chemical engineer, complemented by instrument engineer, supplemented by Contractor's staff, shall comprise the training staff.

D. Training materials shall include "survey," limits control program, shop drawings, operating and maintenance manuals, safe handling of chemicals, chemical testing, use of log sheets and demonstrations of installed and functioning systems.

E. On completion of the installation of the entire purified water system, conduct a thorough check and test of all components in the system. During this period, instruct the Owner's personnel in the theory, operation, and maintenance of the system. When this work is finished, start up the system and operate it for as long as necessary to complete two consecutive days of operation at the specified performance levels. During this period, continue to instruct the Owner's personnel.

1.7 MAINTENANCE SERVICE

A. Scope of Maintenance Service: Provide chemicals and service program to maintain water conditions required above to inhibit corrosion, scale formation, and biological growth for heating, hot-water piping and equipment. Services and chemicals shall be provided for a period of one year from date of Substantial Completion, and shall include the following:
1. Provide piping/plumbing recommendation to optimize chemical program results.
2. Initial water analysis and HVAC water-treatment recommendations.
3. Startup assistance for Contractor to flush the systems, clean with detergents, and initially fill systems with required chemical treatment prior to operation.
4. Quarterly field service and consultation.
5. Customer report charts and log sheets.
6. Laboratory technical analysis.
7. Analyses and reports of all chemical items concerning safety and compliance with government regulations.

B. Glycol manufacturer shall provide testing services every six months of samples submitted by the Owner. Fluid shall be tested at no charge for: glycol percent, pH, reserve alkalinity, dissolved metals, magnesium, calcium, chlorides, acidity, and inhibitor components. Testing service shall be for the life of the fluid.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers/Suppliers: Unless otherwise specified, and subject to compliance with requirements, provide products by one of the following:

1. Ashland Specialty Chemical Company; Drew Industrial Div.
2. Eldon Water.
3. Enerco Corporation.
5. Mitco Custom Water Treatment.

2.2 MANUAL CHEMICAL-FEED EQUIPMENT

A. Bypass Feeders: Steel, with corrosion-resistant exterior coating, minimum 3-1/2-inch fill opening in the top, and NPS 3/4 bottom inlet and top side outlet. Quarter turn or threaded fill cap with gasket seal and diaphragm to lock the top on the feeder when exposed to system pressure in the vessel.

2.3 CHEMICAL FEED PIPE AND FITTINGS

A. CPVC Piping:

1. CPVC Schedule 80 Pipe: ASTM F 441/ F 441M.
2. CPVC Schedule 80 Fittings: ASTM F 439, socket type or ASTM F 437, threaded type.
3. Isolation Valves: Three-piece true union style ball valve constructed of CPVC with TFE seats, and FPM or EPDM o-ring seals.

2.4 CHEMICALS

A. Chemicals shall be as recommended by water-treatment system manufacturer that are compatible with piping system components and connected equipment, and that can attain water quality specified in Part 1 "Performance Requirements" Article.

PART 3 - EXECUTION

3.1 WATER ANALYSIS

A. Perform an analysis of supply water to determine quality of water available at Project site.

3.2 INSTALLATION

A. Install chemical application equipment on concrete bases, level and plumb. Maintain manufacturer's recommended clearances. Arrange units so controls and devices that require servicing are accessible. Anchor chemical tanks and floor-mounting accessories to substrate.

B. Install water testing equipment on wall near water chemical application equipment.

C. Install meters and equipment requiring service at a maximum 60 inches above finished floor.

D. Install interconnecting control wiring for chemical treatment controls and sensors.

E. Mount sensors and injectors in piping circuits.
F. Bypass Feeders: Install in hot-water heating closed hydronic systems and equipped with the following:

1. Install bypass feeder in a bypass circuit on main header having pressure differential greater than or equal to 20 psig, unless otherwise indicated on Drawings.
2. Install water meter in makeup water supply.
3. Install test-coupon assembly in bypass circuit around circulating pumps, unless otherwise indicated on Drawings.
4. Install a gate or full-port ball isolation valves on inlet, outlet, and drain below feeder inlet.
5. Install a swing check on inlet after the isolation valve.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

C. Make piping connections between HVAC water-treatment equipment and dissimilar-metal piping with dielectric fittings. Dielectric fittings are specified in Division 15 Section "Basic Mechanical Materials and Methods."

D. Install shutoff valves on HVAC water-treatment equipment inlet and outlet. Metal general-duty valves are specified in Division 15 Section "Valves."

E. Refer to Division 15 Section "Domestic Water Piping Specialties" for backflow preventers required in makeup water connections to potable-water systems.

3.4 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.

C. Tests and Inspections:

1. Inspect field-assembled components and equipment installation, including piping and electrical connections.

2. Inspect piping and equipment to determine that systems and equipment have been cleaned, flushed, and filled with water, and are fully operational before introducing chemicals for water-treatment system.

3. Place HVAC water-treatment system into operation and calibrate controls during the preliminary phase of HVAC systems' startup procedures.

4. Do not enclose, cover, or put piping into operation until it is tested and satisfactory test results are achieved.

5. Test for leaks and defects. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.

6. Leave uncovered and unconcealed new, altered, extended, and replaced water piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved.

7. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow test pressure to stand for four hours. Leaks and loss in test pressure constitute defects.

8. Repair leaks and defects with new materials and retest piping until no leaks exist.

D. Equipment will be considered defective if it does not pass tests and inspections.

E. Remove and replace malfunctioning units and retest as specified above.

F. Sample boiler water at one-week intervals after boiler startup for a period of five weeks, and prepare test report advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article for each
required characteristic. Sample boiler water at four-week intervals following the testing noted above to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section.

G. At four-week intervals following Substantial Completion, perform separate water analyses on hydronic systems to show that automatic chemical-feed systems are maintaining water quality within performance requirements specified in this Section. Submit written reports of water analysis advising Owner of changes necessary to adhere to Part 1 "Performance Requirements" Article.

H. Comply with ASTM D 3370 and with the following standards:


3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC water-treatment systems and equipment.
SECTION 15194 - FUEL GAS PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
B. Related Sections include the following:

   1. Division 15 Section “Mechanical General Requirements.”
   2. Division 15 Section “Basic Mechanical Materials and Methods.”

1.2 SUMMARY

A. This Section includes facility fuel gas piping.

B. Service meter assemblies will be furnished and installed by utility company.

1.3 DEFINITIONS

A. Gas Main: Utility's natural gas piping.

B. Gas Distribution: Piping from gas main to individual service-meter assemblies.

C. Service-Meter Assembly: Piping, valves, service regulator, and specialties.

D. Point of Delivery: Piping outlet from service-meter assembly.

E. Fuel Gas Piping: Piping that conveys fuel gas from point of delivery to fuel gas utilization devices inside the building.

F. PE: Polyethylene.

1.4 PERFORMANCE REQUIREMENTS

A. Minimum Operating-Pressure Ratings:

   1. Piping and Valves: Performance requirements are scheduled on the Drawings.
   2. Exception: Fuel Gas Piping Installed within Ceilings Used as Plenums: 150 psig.

1.5 SYSTEMS DESCRIPTIONS

A. Fuel gas piping system materials are scheduled on the Drawing.
1.6 SUBMITTALS

A. Product Data: For the following:
   1. Specialty valves. Include pressure rating, capacity, settings, and electrical connection data of selected models.
   2. Service meters. Include pressure rating and capacity of selected models.
   3. Pressure regulators. Include pressure rating, capacity, and settings of selected models.

B. Shop Drawings: For fuel gas piping. Include plans and attachments to other work.

C. Coordination Drawings: Plans and details, drawn to scale, on which natural-gas piping is shown and coordinated with other installations, using input from installers of the items involved.

D. Welding certificates.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For natural gas specialties and accessories to include in operation and maintenance manuals.
   1. Lubricated Plug Valves: Installation, operation, lubrication, and leak testing procedures.

1.7 QUALITY ASSURANCE

A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, “Welding and Brazing Qualifications.”


1.8 DELIVERY, STORAGE, AND HANDLING

A. Handling Flammable Liquids: Remove and legally dispose of liquids from drips in existing gas piping. Handle cautiously to avoid spillage and ignition. Notify fuel gas supplier. Handle flammable liquids used by Installer with
proper precautions and do not leave on premises from end of one day to beginning of next day.

B. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

C. Store and handle pipes and tubes having factory-applied protective coatings to avoid damaging coating, and protect from direct sunlight.

D. Protect stored PE pipes and valves from direct sunlight.

1.9 PROJECT CONDITIONS

A. Perform site survey, research public utility records, and verify existing utility locations. Contact utility-locating service for area where Project is located.

B. Gas System Pressure: Not more than 5.0 psig.

C. Design values of fuel gas supplied for these systems are as follows:

1. Nominal Heating Value: 1000 Btu/cu. ft.
2. Nominal Specific Gravity: 0.6.

1.10 COORDINATION

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect not less than two days in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Architect's written permission.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate requirements for access panels and doors for valves installed concealed behind finished surfaces.
Comply with requirements in Division 08 Section "Access Doors and Frames."

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 BLACK STEEL PIPE AND FITTINGS

A. Black Steel Pipe: ASTM A 53/A 53M; Type E or S; Grade B; Schedule 40. Wall thickness of wrought-steel pipe shall comply with ASME B36.10M.

2. Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.
7. Steel Flanges and Flanged Fittings: ASME B16.5.
8. Gasket Material: Thickness, material, and type suitable for natural gas.

2.3 PIPING SPECIALTIES


B. 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 and smaller; flanged ends for NPS 2-1/2 and larger.

3. Strainer Screen: 40-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.


C. Weatherproof Vent Cap: Cast- or malleable-iron increaser fitting with corrosion-resistant wire screen, with free area at least equal to cross-sectional area of connecting pipe and threaded-end connection.

2.4 JOINING MATERIALS

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods.”

2.5 SPECIALTY VALVES

A. Valves, NPS 3 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.

B. Valves, NPS 4: Threaded ends according to ASME B1.20.1 for pipe threads; or flanged ends according to ASME B16.5 for steel flanges.

C. Valves, NPS 6 and Larger: Flanged ends according to ASME B16.5 for steel flanges.

D. Natural Gas Valves, NPS 3 and Smaller: Use the following:

1. Ball Valves: Bronze or brass body with AGA or CSA stamp, UL listed or FM approved for service, with chrome-plated brass ball and lever handle; 125-psig minimum pressure rating.

   a. Manufacturers:

   1) Apollo Valve; Conbraco Industries, Inc.
   2) Jomar International Ltd.
   3) Legend Valve and Fitting, Inc.
   4) NIBCO INC.

   b. Tamperproof Feature: Include design for locking.
E. Natural Gas Valves, NPS 4: Use any of the following:

1. Cast-Iron, Eccentric Plug Valves:
   a. Manufacturers:
      1) Homestead Valve; a division of Olson Technologies, Inc.; Keycentric Series 300.
      2) Milliken Valve Company; Mueller Water Products; Model 625.
   b. Approvals: UL approved.
   c. Body: Cast iron, complying with ASTM A 126, Class B.
   d. Plug: Bronze or nickel-plated cast iron.
   e. Stem Seal: Compatible with natural gas.
   f. Resilient Plug Seal: Compatible with natural gas.
   g. Operator: Square head or lug type with tamperproof feature where indicated.
   h. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
   i. Pressure Class: 125 psig.

   a. Manufacturers:
      1) Flowserve Nordstrom.
      2) Homestead Valve; a division of Olson Technologies, Inc.
      3) R&M Energy Systems, a Unit of Robbins & Myers, Inc.; Resun.
   b. Body: Cast iron, complying with ASTM A 126, Class B.
   c. Plug: Bronze or nickel-plated cast iron.
   d. Seat: Coated with thermoplastic.
   e. Stem Seal: Compatible with natural gas.
   f. Operator: Square head or lug type with tamperproof feature where indicated.
   g. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every 10 plug valves, for each size square plug head.
   h. Pressure Class: 125 psig.
2.6 SERVICE METERS

A. Turbine Meters: Axial-flow type suitable for fuel gas service. Comply with construction criteria for axial-flow, gas turbine meters in ASME MFC-4M. Include metal body, corrosion-resistant internal components, and flow registered in cubic feet. Equip meter with a pulse transmitter having an output of 1 pulse per 100 cfh.

1. Manufacturers:
   a. American Meter Company.
   b. IMAC.
   c. Sensus Metering Systems Inc.

2. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
3. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges.

2.7 PRESSURE REGULATORS

A. Description: Single stage and suitable for fuel gas service. Include steel jacket and corrosion-resistant components, elevation compensator, and atmospheric vent.

1. Manufacturers:
   a. Service Pressure Regulators:
      1) Elster Gas North America; Elster American Meter.
      3) Itron Gas.
   b. Line Pressure Regulators:
      1) Elster Gas North America; Elster American Meter.
      3) Itron Gas.

2. NPS 2 and Smaller: Threaded ends according to ASME B1.20.1 for pipe threads.
3. NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel flanges.

B. Pressure Regulator Vents: Factory- or field-installed, corrosion-resistant screen in opening if not connected to vent piping.

PART 3 - EXECUTION

3.1 EXCAVATION

A. Refer to Division 02 Section “Earthwork” for excavating, trenching, and backfilling.

3.2 EXAMINATION

A. Examine roughing-in for fuel gas piping system to verify actual locations of piping connections before equipment installation.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

A. Close equipment shutoff valves before turning off natural gas to premises or piping section.

B. Inspect natural-gas piping according to NFPA 54 and the International Fuel Gas Code to determine that natural-gas utilization devices are turned off in piping section affected.

C. Comply with NFPA 54 and the International Fuel Gas Code requirements for prevention of accidental ignition.
3.4 SERVICE-METER ASSEMBLY INSTALLATION

A. Service meter assembly will be installed by the fuel gas utility company.

B. Install service-meter assemblies aboveground.

1. Set service-meter assembly on, or supported over, precast concrete bases. Excavate earth and make level beds to support bases. Set bases level with top surface projecting 3 inches above finished grade. Concrete bases are specified in Division 15 Section "Basic Mechanical Materials and Methods."

C. Include gas valve or plug valve, strainer, service pressure regulator, and service meter for each assembly.

D. Install gas valve or plug valve and strainer upstream from each service pressure regulator.

E. Install service pressure regulators with vent outlet turned down and with corrosion-resistant-metal insect screen.

F. Install pressure gage upstream and downstream from each service pressure regulator. Pressure gages are specified in Division 15 Section "Meters and Gages."

G. Install service meters downstream from service pressure regulators.

1. Service meters with connections larger than NPS 1 supported from piping or set on concrete bases.

3.5 SERVICE ENTRANCE PIPING

A. Extend fuel gas piping and connect to fuel gas distribution for service entrance to building.

1. Exterior fuel gas distribution system piping, service pressure regulator, and service meter will be provided by gas utility.

2. Refer to Article entitled "Codes, Permits and Fees" in Division 15 Section "Mechanical General Requirements" for additional requirements.
B. Install dielectric fitting downstream from and adjacent to each service meter unless meter is supported from service-meter bar with integral dielectric fitting. Install shutoff valve downstream from and adjacent to dielectric fitting. Dielectric fittings are specified in Division 15 Section "Basic Mechanical Materials and Methods."

3.6 PIPING SYSTEM INSTALLATION


B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Basic piping installation requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

D. Conceal pipe installations in walls, pipe spaces, utility spaces, above ceilings, below grade or floors, and in floor channels, unless indicated to be exposed to view.

E. Concealed Locations:

1. Above Inaccessible Ceiling Locations: Gas piping with welded joints may be installed in inaccessible spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves or unions above inaccessible ceilings.

2. Above Accessible Ceiling Locations: Gas piping with welded joints may be installed in accessible ceiling spaces, subject to approval of authorities having jurisdiction, whether or not such spaces are used as plenums. Do not locate valves or unions above ceilings used as plenums.

3. In Partitions: Do not install concealed piping in solid partitions, unless installed in a chase or casing.
a. Exception: Piping passing through partitions or walls.

4. In Walls: Gas piping with welded joints and protective wrapping specified in Part 2 "Protective Coating" Article may be installed in masonry walls, subject to approval of authorities having jurisdiction.

5. Prohibited Locations: Do not install gas piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.

F. Drips and Sediment Traps: Install drips at points where condensate may collect. Include outlets of service meters. Locate where readily accessible for cleaning and emptying. Do not install where condensate would be subject to freezing.

1. Construct drips and sediment traps using tee fitting with bottom outlet plugged or capped. Use minimum-length nipple of 3 pipe diameters, but not less than 3 inches long, and same size as connected pipe. Install with space between bottom of drip and floor for removal of plug or cap.

G. Install fuel gas piping at uniform grade of 0.1 percent slope upward toward risers.

H. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

I. Connect branch piping from top or side of horizontal piping.

J. Install strainer on inlet of each automatic and electrically operated valve.

K. Install pressure gage upstream and downstream from each line pressure regulator. Pressure gages are specified in Division 15 Section "Meters and Gages."

L. Locate valves for easy access.

M. Install unions in pipes NPS 2 and smaller, adjacent to each valve, at final connection to each piece of equipment, and elsewhere as indicated. Unions are not required on flanged devices.
N. Install flanges when connecting to valves, specialties, and equipment having NPS 2-1/2 and larger connections.

O. Install gas valve or plug valve and strainer upstream from each line pressure regulator or appliance pressure regulator.

P. Install vent piping for gas pressure regulators and gas trains, extend outside building, and vent to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end.

Q. Install containment conduits for gas piping below slabs, within building, in gastight conduits extending minimum of 4 inches outside building, and vented to atmosphere. Terminate vents with turned-down, reducing-elbow fittings with corrosion-resistant insect screens in large end. Prepare and paint outside of conduits with coal-tar, epoxy-polyamide paint according to SSPC-Paint 16.

3.7 JOINT CONSTRUCTION

A. Basic piping joint construction is specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Use materials suitable for fuel gas.

C. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.8 HANGER AND SUPPORT INSTALLATION

A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 15 Section "Hangers and Supports."

B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:

1. NPS 1 and Smaller: Maximum span, 96 inches; minimum rod size, 3/8 inch.
2. NPS 1-1/4: Maximum span, 108 inches; minimum rod size, 3/8 inch.
3. NPS 1-1/2 and NPS 2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
4. NPS 2-1/2 to NPS 3-1/2: Maximum span, 10 feet; minimum rod size, 1/2 inch.
5. NPS 4 and Larger: Maximum span, 10 feet; minimum rod size, 5/8 inch.

C. Support vertical steel pipe at each floor and at spacing not greater than 15 feet.

3.9 CONNECTIONS

A. Drawings indicate general arrangement of fuel gas piping, fittings, and specialties.

B. Install piping adjacent to appliances to allow service and maintenance.

C. Connect piping to appliances using gas with shutoff valves and unions. Install valve upstream from and within 72 inches of each appliance. Install union downstream from valve.

D. Sediment Traps: Install tee fitting with capped nipple in bottom to form drip, as close as practical to inlet of each appliance using gas.

3.10 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each service meter, pressure regulator, and specialty valve.

1. Text: In addition to name of identified unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

2. Nameplates, pipe identification, and signs are specified in Division 15 Section "Mechanical Identification."

3. Trace Wire: Yellow insulated, minimum 18 AWG wire, having copper or other approved conductor, with insulation suitable for direct burial, installed adjacent to underground nonmetallic piping, with aboveground access to tracer wire at each end of pipe.
3.11 PAINTING

A. Use materials and procedures in Division 09 painting Sections.

B. Paint exposed, exterior metal piping, valves, service regulators, service meters and meter bars, earthquake valves, and piping specialties, except components, with factory-applied paint or protective coating.

1. Alkyd System: MPI EXT 5.1D.
   c. Color: Gray.

C. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.12 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base.

1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Install anchor bolts to elevations required for proper attachment to supported equipment.
6. Use 3000-psig, 28-day, compressive-strength concrete and reinforcement as specified in Division 03.

3.13 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections:

1. Test, inspect, and purge natural gas according to NFPA 54 and the International Fuel Gas Code and authorities having jurisdiction.

C. Additional Testing: Subject welded fuel gas piping installed within ceiling spaces used as plenums to test pressure of 150 psig for a minimum of 2 hours.

D. Natural-gas piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.14 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to operate, and maintain lubricated plug valves.

END OF SECTION 15194
SECTION 15410 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 10 Section "Toilet and Bath Accessories."
2. Division 15 Section "Mechanical General Requirements."
3. Division 15 Section "Basic Mechanical Materials and Methods."
4. Division 15 Section "Medical Plumbing Fixtures."
5. Division 15 Section "Security Plumbing Fixtures."
6. Division 15 Section "Drinking Fountains and Water Coolers."
7. Division 15 Section "Domestic Water Piping Specialties" for backflow preventers; individual-fixture, water tempering valves; and specialty fixtures not included in this Section.
8. Division 15 Section “Drainage Piping Specialties” for floor drains, and specialty fixtures not included in this Section.

1.2 DEFINITIONS


B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Cast Polymer: Cast-filled-polymer-plastic material. This material includes cultured-marble and solid-surface materials.

D. Cultured Marble: Cast-filled-polymer-plastic material with surface coating.

E. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

F. FRP: Fiberglass-reinforced plastic.

G. PMMA: Polymethyl methacrylate (acrylic) plastic.

H. PVC: Polyvinyl chloride plastic.


1.3 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.
D. Operation and Maintenance Data: For plumbing fixtures and trim to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.

1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.


E. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components - Lead Content for potable domestic water piping and components.

G. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

H. Comply with applicable ANSI, ASME, ASSE, ASTM, ICC, NSF, and UL standards and other requirements specified for plumbing fixtures, trim, fittings, components, and features.
PART 2 - PRODUCTS

2.1 PLUMBING FIXTURES

A. Refer to Plumbing fixture Schedule on the Drawings.

2.2 FIXTURE SUPPLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. BrassCraft; a Masco Company.
3. Any of the approved plumbing fixture manufacturers.

B. Description: Chrome-plated brass, loose-key or screwdriver angle stops with brass stems; rigid, chrome-plated copper risers; and chrome-plated wall flanges.

2.3 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Engineered Brass Co.
   b. Insul-Tect Products Co.; a Subsidiary of MVG Molded Products.
   c. McGuire Manufacturing Co., Inc.
   d. Plumberex Specialty Products Inc.
   e. TCI Products; SG-200BV.
   f. TRUEBRO, Inc.
   g. Zurn Plumbing Products Group; Z8946-3-NT.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Sloan Valve Co.
b. TRUEBRO, Inc.
c. Zurn Plumbing Products Group; Z6900-VG

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

2.4 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Company.
2. MIFAB Manufacturing Inc.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.

B. Water-Closet Supports:

1. Description: Combination carrier designed for wall-mounting, water-closet-type fixture. Include:

   a. Single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement.
   b. Faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture.
   c. Cast iron nipple and coupling kit.
   d. Additional extension coupling, faceplate, and feet for installation in wide pipe space.

C. Urinal Supports:

1. Description: For wall-mounting, urinal-type fixture. Include steel uprights with feet.

D. Lavatory Supports:
1. Description: Lavatory carrier with concealed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.


E. Sink Supports:

1. Description: For wall-mounting sink-type fixture. Include steel uprights with feet.
   a. Type I, sink carrier with exposed arms and tie rods.
   b. Type II, sink carrier with hanger plate, bear studs, and tie rod.
   c. Type III, sink carrier with hanger plate and exposed arms.

2.5 DISPOSERS

A. Refer to Plumbing Fixture Schedule on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.

1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install floor-mounting fixtures on closet flanges or other attachments to piping or building substrate.

E. Install wall-mounting fixtures with tubular waste piping attached to supports.

F. Install counter-mounting fixtures in and attached to casework.

G. Install fixtures level and plumb according to roughing-in drawings. Install accessible fixtures at heights required by local codes.

H. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.

1. Exception: Fixtures with flushometer valves, and faucets or valves with integral stops.

I. Install ASSE 1070 water-temperature limiting devices on supplies for lavatories and sinks that will be used for handwashing, and where specified. Refer to Division 15 Section “Domestic Water Piping Specialties.”

J. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

K. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

L. Install protective shielding guards on exposed traps and supplies of lavatories, and sinks used for hand washing.

M. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.
N. Install toilet seats on water closets.

O. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

P. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

Q. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

R. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

S. Install disposer in outlet of each sink indicated to have disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

T. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 15 Section "Basic Mechanical Materials and Methods."

U. Set service basins in leveling bed of cement grout. Grout is specified in Division 15 Section "Basic Mechanical Materials and Methods."

V. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Section. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Individual water line branches, waste lines, vents, and traps for connection to individual fixtures, fixture fittings and specialties shall be in accordance with the schedule on the Drawings.

D. Ground equipment according to Division 16 Section "Grounding and Bonding."

E. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Operate and adjust disposers and controls. Replace damaged and malfunctioning units and controls.

C. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 15410
SECTION 15413 - SECURITY PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 10 Section "Toilet and Bath Accessories."
2. Division 15 Section "Mechanical General Requirements."
3. Division 15 Section "Basic Mechanical Materials and Methods."
4. Division 15 Section "Plumbing Fixtures."
5. Division 15 Section "Drinking Fountains and Water Coolers."

1.2 DEFINITIONS

A. Accessible Fixture: Security plumbing fixture that can be approached and used by people with disabilities.
B. Back-Mounting-Type Fixture: Security plumbing fixture designed to mount on wall sleeve built into wall so installation and removal of fixture and piping and other components are only accessible from service space behind wall.

C. Front-Mounting-Type Fixture: Security plumbing fixture designed to mount on fixture support with installation and removal from fixture side of wall, and piping and other components are accessible from access panels in fixture or wall.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include furnished specialties and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For security plumbing fixtures to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components - Lead Content for potable domestic water piping and components.


D. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.
E. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Flushometer Valves: Equal to 10 percent of amount installed for each type indicated, but no fewer than one unit.

PART 2 - PRODUCTS

2.1 COMBINATION UNITS – REFER TO PLUMBING FIXTURE SCHEDULE ON DRAWINGS

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before security plumbing fixture installation.

B. Examine floors and walls for suitable conditions where security plumbing fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SECURITY PLUMBING FIXTURE INSTALLATION

A. Install back-mounting-type, stainless-steel security plumbing fixtures as follows:

1. Install wall sleeve in wall.
2. Install fixture on wall sleeve; mount components on or attached to wall sleeve with access from accessible service space.
3. Extend supply piping from service space to fixture.
4. Install soil and waste piping from fixture and extend into service space.
5. Install fixture trap in service space instead of below fixture drain.

B. Install front-mounting-type, stainless-steel security plumbing fixtures as follows:

1. Install fixture support or mounting bracket.
2. Install fixture on support; mount components inside of or attached to fixture.
3. Extend supply piping from pipe space to fixture.
4. Install trap below fixture and extend soil and waste piping into pipe space.

C. Install security plumbing fixture outlets with gasket seals.

D. Install fixtures designated "accessible" according to ICC A117.1 for heights, dimensions, and clearances.

E. Install fixtures level and plumb.

F. Install shutoff valves in water-supply piping to fixtures. Use ball, gate, or globe valve if specific type valve is not indicated. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 15 Section "General Duty Valves for Plumbing."

G. Install dielectric fittings in water-supply piping to fixtures if piping and fixture connections are made of different metals. See Division 15 Section "Basic Mechanical Materials and Methods" for dielectric fittings.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect hot- and cold-water supply piping to security plumbing fixtures. Include supply stops, if specified, or ball valve on each supply. Ball valves are specified in Division 15 Section "General Duty Valves for Plumbing."

C. Connect soil and waste piping to security plumbing fixtures.
3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Testing: After installing security plumbing fixtures, test for compliance with requirements.
2. Remove and replace malfunctioning security plumbing fixtures. Retest as specified above after repairs or replacements are made.

3.5 ADJUSTING

A. Operate and adjust water-supply flushometers and flow-control valves on security plumbing fixtures.

3.6 CLEANING

A. Clean security plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:

1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall spouts and strainers.
2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed security plumbing fixtures and fittings.

B. Do not allow use of security plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 15413
PART 1 - GENERAL

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

B. Related Sections include the following:
   1. Division 15 Section “Mechanical General Requirements.”
   2. Division 15 Section “Basic Mechanical Materials and Methods.”

1.2 DEFINITIONS
A. Accessible Drinking Fountain or Water Cooler: Fixture that can be approached and used by people with disabilities.

B. Cast Polymer: Dense, cast-filled-polymer plastic.

C. Drinking Fountain: Fixture with nozzle for delivering stream of water for drinking.
D. Fitting: Device that controls flow of water into or out of fixture.

E. Fixture: Drinking fountain or water cooler.

F. Remote Water Cooler: Electrically powered equipment for generating cooled drinking water.

G. TDS: Total dissolved solids.

H. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.3 SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a NRTL acceptable to authorities having jurisdiction, and marked for intended use.


D. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

E. AHRI Standard: Comply with AHRI's "Directory of Certified Drinking Water Coolers" for style classifications.

G. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

PART 2 - PRODUCTS

2.1 ELECTRIC WATER COOLERS

A. Refer to Plumbing Fixture Schedule on the drawings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Halsey Taylor; SCWT Series.
   c. Haws Corporation; HF Series.
   d. Murdock Manufacturing; A Member of Morris Group International; A611108F.
   e. Oasis Corporation; PLF Series.
   f. Sunroc Corp.; NSF Series.

2.2 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Josam Co.
2. MIFAB Manufacturing, Inc.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.

B. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods
and bearing plates with mounting studs matching fixture to be supported.

1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use mounting frames for recessed water coolers, unless otherwise indicated.

C. Set freestanding and pedestal drinking fountains on floor.

D. Set remote water coolers on floor, unless otherwise indicated.

E. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.
3.3 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 15 Section "General Duty Valves for Plumbing."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 15 Section "Basic Mechanical Materials and Methods."

G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 7 Section "Joint Sealants."

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 16 Section "Grounding and Bonding."
D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.

1. Remove and replace malfunctioning units and retest as specified above.
2. Report test results in writing.

3.6 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

3.7 CLEANING

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION 15415
SECTION 15441 - DOMESTIC WATER CIRCULATION PUMPS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”
3. Division 15 Section “Packaged Booster Pumps” for booster systems.
4. Division 15 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”

1.2 SUBMITTALS

A. Product Data: For each type and size of domestic water pump specified. Include certified performance curves with
operating points plotted on curves; and rated capacities of selected models, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For domestic water pumps to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of domestic water pumps and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. Regulatory Requirements: Comply with requirements in Public Law 111-380, "Reduction of Lead in Drinking Water Act," about lead content in materials that will be in contact with potable water for human consumption.

D. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9," and NSF 372 Drinking Water System Components - Lead Content for potable domestic water piping and components.

E. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.

B. Protect bearings and couplings against damage.

C. Comply with pump manufacturer's written rigging instructions for handling.
1.5 COORDINATION

A. Coordinate size and location of concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CLOSE COUPLED, IN-LINE, SEALLESS CENTRIFUGAL PUMPS

A. Manufacturers:

1. Armstrong Pumps Inc.; Astro.
2. Bell & Gossett; Xylem Inc.; Series LR and NBF.
3. Grundfos Pumps Corp.
4. Taco, Inc.

B. Description: Factory-assembled and -tested, single-stage, close-coupled, in-line, sealless centrifugal pumps as defined in HI 5.1-5.6.

1. Pump and Motor Assembly: Hermetically sealed, replaceable-cartridge-type unit with motor and impeller on common shaft and designed for installation with pump and motor shaft mounted horizontally.
2. Casing: Bronze, with threaded companion-flange connections.
3. Impeller: Corrosion-resistant material.
4. Motor: Single speed, unless otherwise indicated. Comply with requirements in Division 15 Section "Motors."

C. Capacities and Characteristics: Refer to Schedule on Drawings.
2.3 CONTROLS

A. Thermostats: Electric; adjustable for control of hot-water circulation pump.

1. Manufacturers:
   a. Honeywell International, Inc.
   b. Square D.

2. Type: Water-immersion sensor, for installation in hot-water circulation piping.
3. Range: 65 to 200 deg F.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
7. Settings: Start pump at 105 deg F and stop pump at 120 deg F.

B. Timers: Electric time clock for control of hot-water circulation pump.

1. Manufacturers:
   a. Honeywell International, Inc.
   b. Intermatic, Inc.
   c. Johnson Controls, Inc.
   d. Maple Chase Company.
   e. TORK.

2. Type: Programmable, seven-day clock with manual override on-off switch.
3. Enclosure: Suitable for wall mounting.
4. Operation of Pump: On or off.
5. Transformer: Provide if required.
7. Programmable Sequence of Operation: Up to two on-off cycles each day for seven days.

2.4 FLEXIBLE CONNECTORS

A. Refer to Division 15 Section “Pipe Flexible Connectors, Expansion Fittings and Loops.”
2.5 BUILDING-AUTOMATION-SYSTEM INTERFACE

A. Provide auxiliary contacts in pump controllers for interface to building automation system. Include the following:

1. On-off status of each pump.
2. Alarm status.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.

B. Install pumps with access for periodic maintenance including removal of motors, impellers, couplings, and accessories.

C. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping. Do not use pump motors as a support point.

D. Install centrifugal pumps with motor and pump shafts horizontal.

E. Install continuous-thread hanger rods and elastomeric hangers of sufficient size to support pump weight. Vibration isolation devices are specified in Division 15 Section "Mechanical Vibration Controls." Fabricate brackets or supports as required. Hanger and support materials are specified in Division 15 Section "Hangers and Supports."

F. Install vertical in-line pumps on concrete bases. Install pumps with motor and pump shafts vertical.
3.3 CONTROL INSTALLATION

A. Install immersion-type thermostats in hot-water return piping.

B. Install timers where indicated on Drawings.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles. Refer to Division 15 Section "Domestic Water Piping."

1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:

2. Install shutoff valve and strainer on suction side of pumps, and check valve and throttling valve on discharge side of pumps. Install valves same size as connected piping. Refer to Division 15 Section "Valves" for general-duty valves for domestic water piping and Division 15 Section "Domestic Water Piping Specialties" for strainers.

3. Install pressure gages at suction and discharge of pumps. Install at integral pressure-gage tappings where provided or install pressure-gage connectors in suction and discharge piping around pumps. Refer to Division 15 Section "Meters and Gages" for pressure gages and gage connectors.

D. Ground equipment according to Division 16 Section "Grounding and Bonding."

E. Connect wiring according to Division 16 Section "Conductors and Cables."
F. Connect thermostats to pumps that they control.

G. Interlock pump with water heater burner and time delay relay.

3.5 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set thermostats for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:
   a. Verify bearing lubrication.
   b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
   c. Verify that pump is rotating in the correct direction.

6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain controls and pumps.

END OF SECTION 15441
SECTION 15486 - FUEL-FIRED DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
1.2 DEFINITIONS
1.3 SUBMITTALS
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1.5 COORDINATION

PART 2 - PRODUCTS

2.1 MANUFACTURERS
2.2 COMMERCIAL, GAS WATER HEATERS
2.3 EXPANSION TANKS
2.4 WATER HEATER ACCESSORIES
2.5 SOURCE QUALITY CONTROL

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION
3.2 CONNECTIONS
3.3 FIELD QUALITY CONTROL
3.4 DEMONSTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Section includes the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”
3. Division 15 Section “Breechings, Chimneys, and Stacks.”

1.2 DEFINITIONS

A. LP Gas: Liquefied-petroleum fuel gas.
1.3 SUBMITTALS

A. Product Data: For each type and size of water heater indicated. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail water heater assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection


C. Product Certificates: For each type of water heater, signed by product manufacturer.

D. Source quality-control test reports.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For water heaters to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain same type of water heaters through one source from a single manufacturer.

B. Product Options: Drawings indicate size, profiles, and dimensional requirements of water heaters and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

D. ASME Compliance:

1. Where ASME-code construction is indicated, fabricate and label commercial water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.
2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

3. Where ASME-code construction is indicated, fabricate and label commercial direct-fired storage water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV, HLW.

E. ASHRAE Standards: Comply with performance efficiencies prescribed for the following:


F. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9" for all components that will be in contact with potable water.

1.5 COORDINATION

A. Coordinate size and location of concrete bases with Architectural and Structural Drawings.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 COMMERCIAL, GAS WATER HEATERS

1. Manufacturers:
   b. Lochinvar Corporation.
   c. Smith, A. O. Water Products Company.

   a. Tappings: Factory fabricated of materials compatible with tank. Attach tappings to tank before testing.
      1) NPS 2 and Smaller: Threaded ends according to ASME B1.20.1.
      2) NPS 2-1/2 and Larger: Flanged ends according to ASME B16.5 for steel and stainless-steel flanges, and according to ASME B16.24 for copper and copper-alloy flanges.
   b. Interior Finish: Comply with NSF 61 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Lining: Glass complying with NSF 61 barrier materials for potable-water tank linings, including extending lining into and through tank fittings and outlets.

3. Factory-Installed, Storage-Tank Appurtenances:
   a. Anode Rod: Replaceable magnesium.
   b. Dip Tube: Provide unless cold-water inlet is near bottom of tank.
   c. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
   d. Insulation: Comply with ASHRAE/IESNA 90.1.
   e. Jacket: Steel with enameled finish.
   f. Burner: For use with power-vent water heaters and for natural-gas fuel.
   g. Automatic Ignition: ANSI Z21.20, electric, automatic, gas-ignition system.
   h. Temperature Control: Adjustable thermostat.
   i. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
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j. Combination Temperature and Pressure Relief Valves: ANSI Z21.22/CSA 4.4. Include one or more relief valve with total relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.


6. Capacity and Characteristics: Refer to Schedule on Drawings.

2.3 EXPANSION TANKS

A. Description: Steel, pressure-rated tank, ASME-code constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.

1. Manufacturers:
   a. AMTROL Inc.
   b. Armstrong Pumps, Inc.
   c. Bell & Gossett; Xylem Inc.
   d. Taco, Inc.
   e. Wessels Co.

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 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
   c. Air-Charging Valve: Factory installed.

3. Capacity and Characteristics: Refer to Schedule on Drawings.
2.4 WATER HEATER ACCESSORIES


B. Gas Pressure Regulators: ANSI Z21.18, appliance type. Include pressure rating, capacity, and pressure differential required between gas supply and water heater.

C. Gas Automatic Valves: ANSI Z21.21, appliance, electrically operated, on-off automatic valve.

D. Combination Temperature and Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than water heater working-pressure rating. Select each relief valve with sensing element that extends into storage tank.

2. Oil-Fired Water Heaters: ASME rated and stamped and complying with ASME PTC 25.3.

E. Pressure Relief Valves: Include pressure setting less than working-pressure rating of water heater.


F. Drain Pans: Corrosion-resistant metal with raised edge. Provide dimensions not less than base of water heater and include drain outlet not less than NPS 3/4.

G. Piping Manifold Kits: Water heater manufacturer's factory-fabricated inlet and outlet piping arrangement for multiple-unit installation. Include piping and valves for field assembly that is capable of isolating each water heater and of providing balanced flow through each water heater.

H. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1 or ASHRAE 90.2.

2.5 SOURCE QUALITY CONTROL

A. Test and inspect water heater storage tanks, specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.
B. Hydrostatically test water heater storage tanks before shipment to minimum of one and one-half times pressure rating.

C. Prepare test reports.

PART 3 - EXECUTION

3.1 WATER HEATER INSTALLATION

A. Install commercial water heaters on concrete bases.

1. Exception: Omit concrete bases for commercial water heaters if installation on stand, bracket, suspended platform, or direct on floor is indicated.

2. Concrete base construction requirements are specified in Division 15 Section "Basic Mechanical Materials and Methods."

B. Install water heaters 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.

C. Install gas water heaters according to NFPA 54.

D. Install gas shutoff valves on gas supplies to gas water heaters without shutoff valves.

E. Install gas pressure regulators on gas supplies to gas water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.

F. Install automatic gas valves on gas supplies to gas water heaters, if required for operation of safety control.

G. Install combination temperature and pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-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.
H. Install combination temperature and pressure relief valves in water piping for water heaters without storage. Extend commercial-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.

I. Install water heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for water heaters that do not have tank drains. Refer to Division 15 Section "General Duty Valves for Plumbing" for hose-end drain valves.

J. Install thermometer on outlet piping of water heaters. Refer to Division 15 Section "Meters and Gages" for thermometers.

K. Install pressure gage(s) on inlet and outlet piping of commercial, fuel-fired water heater piping. Refer to Division 15 Section "Meters and Gages" for pressure gages.

L. Install piping-type heat traps on inlet and outlet piping of water heater storage tanks without integral or fitting-type heat traps.

M. Fill water heaters with water.

N. Install expansion tanks with isolation and drain valves. Charge expansion tanks with air.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to water heaters to allow service and maintenance. Arrange piping for easy removal of water heaters.

C. Connect vent to full size of water heater flue outlet. Refer to Division 15 Section "Breechings, Chimneys, and Stacks" for venting materials.

D. Ground equipment according to Division 16 Section "Grounding and Bonding."
E. Connect wiring according to Division 16 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Leak Test: After installation, test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, confirm proper operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace water heaters that do not pass tests and inspections and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain water heaters.

END OF SECTION 15486
SECTION 15513 - CONDENSING BOILERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”
3. Division 15 Section “HVAC Water Treatment” for corrosion inhibitors required for modular cast-aluminum condensing boilers.
4. Division 15 Section "Breeching, Chimneys, and Stacks."

1.2 SUMMARY

A. This Section includes packaged, factory-fabricated and -assembled, gas-fired, stainless steel vertical fire-tube...
condensing boilers, trim, and accessories for generating hot water.

1.3 SUBMITTALS

A. Product Data: Include performance data, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: For boilers, boiler trim, and accessories. Include plans, elevations, sections, details, and attachments to other work.

1. Design calculations and vibration isolation base details.
   a. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
   b. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails and equipment mounting frames.

2. Wiring Diagrams: Power, signal, and control wiring.

C. Source quality-control test reports.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For boilers to include in operation and maintenance manuals.

F. Other Informational Submittals:
   1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.
B. ASME Compliance: Fabricate and label boilers to comply with ASME Boiler and Pressure Vessel Code.

C. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."


E. UL Compliance: Test boilers for compliance with UL 795, "Commercial-Industrial Gas Heating Equipment." Boilers shall be listed and labeled by a NRTL acceptable to authorities having jurisdiction.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL VERTICAL FIRE-TUBE CONDENSING BOILERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AERCO International; Benchmark Series.
4. Lochinvar Corporation; Knight KH Series Fire Tube Boilers, FTXL, and Crest Series.

B. Description: Factory-fabricated, -assembled, and -tested, vertical fire-tube condensing boiler with heat exchanger sealed pressure tight, built on a steel base; including insulated jacket; flue-gas vent; combustion-air intake connections; water supply, return, and condensate drain connections; and controls. Water heating service only.

C. Heat Exchanger: Corrosion-resistant stainless steel combustion chamber.
D. Pressure Vessel: Stainless steel with welded heads and tube connections.

E. Burner: Natural gas, forced draft.

F. Blower: Centrifugal fan to operate during each burner firing sequence and to prepurge and postpurge the combustion chamber.

1. Motors: Comply with requirements specified in Division 15 Section "Motors."
   a. 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.

G. Gas Train: Combination gas valve with manual shutoff and pressure regulator.

H. Ignition: Spark ignition with 100 percent main-valve shutoff with electronic flame supervision.

I. Casing:
   1. Jacket: Sheet metal, with snap-in or interlocking closures.
   2. Control Compartment Enclosures: NEMA 250, Type 1A.
   3. Finish: Baked-enamel or powder-coated protective finish.
   4. Insulation: Minimum 2-inch-thick, mineral-fiber or polyurethane-foam insulation surrounding the heat exchanger.
   6. Mounting base to secure boiler.

J. Characteristics and Capacities: Refer to Schedule on Drawings.

2.2 HOT-WATER BOILER TRIM

A. Include devices sized to comply with ANSI B31.1, "Power Piping."

B. Aquastat Controllers: Operating, firing rate, and high limit.
C. Safety Relief Valve: ASME rated.

D. Pressure and Temperature Gage: Minimum 3-1/2-inch-diameter, combination water-pressure and temperature gage. Gages shall have operating-pressure and temperature ranges so normal operating range is about 50 percent of full range.

E. Boiler Air Vent: Automatic.


G. Circulation Pump: Non-overloading, in-line pump with split-capacitor motor having thermal-overload protection and lubricated bearings; designed to operate at specified boiler pressures and temperatures.

2.3 CONTROLS

A. Refer to Division 15 Section "Temperature Controls."

B. Boiler operating controls shall include the following devices and features:

1. Control transformer.
2. Set-Point Adjust: Set points shall be adjustable.
3. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to maintain space temperature in response to thermostat with heat anticipator located in heated space.
4. Sequence of Operation: Electric, factory-fabricated and field-installed panel to control burner firing rate to reset supply-water temperature inversely with outside-air temperature. At 0 deg F outside-air temperature, set supply-water temperature at 200 deg F; at 60 deg F outside-air temperature, set supply-water temperature at 140 deg F.

   a. Include automatic, alternating-firing sequence for multiple boilers to ensure maximum system efficiency throughout the load range and to provide equal runtime for boilers.

5. Provide contacts for connection to remote shutdown switch(es). Activation of remote shutdown switch shall cut power to the burner controls. Refer to
Division 15 Section “Temperature Controls” for remote shutdown switches.

C. Burner Operating Controls: To maintain safe operating conditions, burner safety controls limit burner operation.

1. High Cutoff: Automatic reset stops burner if operating conditions rise above maximum boiler design temperature.
2. Low-Water Cutoff Switch: Electronic probe shall prevent burner operation on low water. Cutoff switch shall be automatic-reset type.
4. Audible Alarm: Factory mounted on control panel with silence switch; shall sound alarm for above conditions.

D. Building Management System Interface: Factory install hardware and software to enable building management system to monitor, control, and display boiler status and alarms.

1. Hardwired Points:
   a. Monitoring: On/off status, common trouble alarm, low water level alarm.
   b. Control: On/off operation, hot water supply temperature set-point adjustment.

2. A communication interface with building management system shall enable building management system operator to remotely control and monitor the boiler from an operator workstation. Control features available, and monitoring points displayed, locally at boiler control panel shall be available through building management system.

2.4 ELECTRICAL POWER

A. Controllers, Electrical Devices, and Wiring: Electrical devices and connections are specified in Division 16 Sections.

B. Single-Point Field Power Connection: Factory-installed and wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection to boiler.
1. House in NEMA 250, Type 1 enclosure.
2. Wiring shall be numbered and color-coded to match wiring diagram.
3. Install factory wiring outside of an enclosure in a metal raceway.
4. Field power interface shall be to lockable, nonfused disconnect switch.
5. Provide branch power circuit to each motor and to controls with a disconnect switch or circuit breaker.
6. Provide each motor with overcurrent protection.

2.5 ACCESSORIES

A. Flue Side Condensate Neutralizer:
   1. Description: Designed to raise the PH level of flue side condensate to near neutral prior to condensate entering the sanitary drainage system.
   2. Materials: Neutralizer constructed of PVC pipe and fittings mounted on channel strut base with galvanized or stainless steel clamps and hardware; and charged with calcium carbonate.
   3. Manufacturers:
      a. BKI Industries, Inc.; Acid Neutralizer Kits.
      b. J.J.M. Boiler Works; JM Neutralizing Tubes.
      c. Neutrasafe Corporation; Neutra-Safe Condensate Neutralizers.
      d. Any of the approved boiler manufacturers.

2.6 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions, and carbon monoxide in flue gas and to achieve combustion efficiency; perform hydrostatic test.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.

C. Allow Owner access to source quality-control testing of boilers. Notify Architect 14 days in advance of testing.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Before boiler installation, examine roughing-in for concrete equipment bases, anchor-bolt sizes and locations, and piping and electrical connections to verify actual locations, sizes, and other conditions affecting boiler performance, maintenance, and operations.

1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 BOILER INSTALLATION

A. Install boilers level on concrete base. Concrete base is specified in Division 15 Section "Basic Mechanical Materials and Methods," and concrete materials and installation requirements are specified in Division 03.

B. Vibration Isolation: Elastomeric isolation pads with a minimum static deflection of 0.25 inch. Vibration isolation devices and installation requirements are specified in Division 15 Section "Mechanical Vibration Controls."

C. Install natural gas-fired boilers according to NFPA 54.

D. Install propane-fired boilers according to NFPA 58.

E. Assemble and install boiler trim.

F. Install electrical devices furnished with boiler but not specified to be factory mounted.

G. Install control wiring to field-mounted electrical devices.
3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to boiler to allow service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect piping to boilers, except safety relief valve connections, with flexible connectors of materials suitable for service. Flexible connectors and their installation are specified in Division 15 Section "Pipe Flexible Connectors, Expansion Fittings and Loops."

E. Connect gas piping to boiler gas-train inlet with union. Piping shall be at least full size of gas train connection. Provide a reducer if required.

F. Connect hot-water piping to supply- and return-boiler tappings with shutoff valve and union or flange at each connection.

G. Install piping from safety relief valves to nearest floor drain.

H. Install piping from safety valves to drip-pan elbow and to nearest floor drain.

I. Boiler Venting:
   1. Install flue venting kit and combustion-air intake.
   2. Connect full size to boiler connections. Comply with requirements in Division 15 Section "Breechings, Chimneys, and Stacks."

J. Ground equipment according to Division 16 Section "Grounding and Bonding."

K. Connect wiring according to Division 16 Section "Conductors and Cables."
3.4 FIELD QUALITY CONTROL

A. 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.

B. Tests and Inspections:
   1. Perform installation and startup checks according to manufacturer's written instructions.
   2. Leak Test: Hydrostatic test. Repair leaks and retest until no leaks exist.
   3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
   4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
      a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
      b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. 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.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain boilers.

END OF SECTION 15513
SECTION 15550 - BREECHINGS, CHIMNEYS, AND STACKS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”
3. Division 15 Section "Draft Control Devices" for induced-draft and mechanical fans and motorized and barometric dampers.
4. Division 15 Section “Metal Ducts” for double-wall factory fabricated grease duct.

1.2 SUBMITTALS

A. Product Data: For the following:

1. Special gas vents.
2. Guy wires and connectors.
B. Shop Drawings: For vents, breechings, chimneys, and stacks. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, methods of field assembly, components, hangers, and location and size of each field connection.
2. Provide engineered sizing data.

C. Welding certificates.

D. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain listed system components through one source from a single manufacturer.


C. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.4 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of venting system that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, structural failures caused by expansion and contraction.
B. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Combustion-Air Intake: Complete system, stainless steel, pipe, vent terminal with screen, inlet air coupling, and sealant.

2.2 LISTED SPECIAL GAS VENT

A. Manufacturers:

1. Cleaver-Brooks, Inc.; CBHL.
2. Heat-Fab, Inc.; Model Saf-T Vent CI.
3. Metal-Fab Inc.; Model Corr/Guard.
4. Schebler Chimney Systems; eVent.
5. Security Chimneys International; Secure Seal SSD.
6. Selkirk Inc.; Selkirk Metalbestos; Model DCV.
7. Van-Packer Co.; Model CS.

B. Description: Double-wall metal vents tested according to UL 1738 and rated for 550 deg F continuously, with positive, negative, or neutral flue pressure, complying with NFPA 211 and suitable for condensing gas-fired appliances.

C. Construction: Inner shell and outer jacket separated by at least 3/32-inch airspace.

D. Inner Shell: ASTM A 959, Type 29-4C stainless steel.

E. Outer Jacket: Aluminized steel indoors and Type 304 stainless steel outdoors.

F. Accessories: Tees, elbows, increasers, draft-hood connectors, terminations, adjustable roof flashings, storm collars, support assemblies, thimbles, firestop spacers, and fasteners; fabricated from similar materials and designs as vent-pipe straight sections; all listed for same assembly.

1. Termination: Round chimney top design to exclude 98 percent of rainwater. A “Pointed Hat” stack cap is not acceptable.
2. Termination: Adjustable wall thimble and horizontal termination with bird screen.

2.3 GUYING AND BRACING MATERIALS

A. Cable: Three galvanized, stranded wires of the following thickness:
   1. Minimum Size: 1/4 inch in diameter.
   2. For ID Sizes 4 to 15 Inches: 5/16 inch.
   3. For ID Sizes 18 to 24 Inches: 3/8 inch.


C. Angle Iron: Three galvanized steel, 2 by 2 by 0.25 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATION


3.3 INSTALLATION OF LISTED VENTS, CHIMNEYS AND STACKS

A. Locate to comply with minimum clearances from combustibles and minimum termination heights according to product listing, local regulations, or NFPA 31 and 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 vents and all accessories, without exceeding appliance loading.
D. Slope breechings down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain.

3.4 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finishes.

B. Clean breechings internally, during and after installation, to remove dust and debris. Clean external surfaces to remove welding slag and mill film. Grind welds smooth and apply touchup finish to match factory or shop finish.

C. Provide temporary closures at ends of breechings, chimneys, and stacks that are not completed or connected to equipment.

END OF SECTION 15550
SECTION 15730 – UNITARY ROOFTOP AIR CONDITIONERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”
3. Division 15 Section “Mechanical Vibration Controls.”
4. Division 15 Section “Common Work Results for HVAC” for common mechanical drive requirements for fans and air handling equipment.

1.2 SUMMARY

A. This Section includes outdoor-mounted unitary air conditioning units smaller than 20 tons.
B. Products supplied but not installed under this Section:
   1. Roof curbs and equipment rails.

1.3 DEFINITIONS
A. DDC: Direct-digital controls.
B. BAS: Building Automation System.

1.4 SUBMITTALS
A. Product Data: Include manufacturer's technical data for each model indicated, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

1.5 QUALITY ASSURANCE
A. AHRI Compliance:
   1. Comply with AHRI 210/240 and AHRI 340/360 for testing and rating energy efficiencies for RTUs.
   2. Comply with AHRI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:
   1. Comply with ASHRAE 15 for refrigeration system safety.
   2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
   3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
1.6 COORDINATION

A. Coordinate size and locations of roof curbs, equipment supports, and roof penetrations. Framing, flashing, and attachment to roof structure are specified under Division 07.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set for each belt-drive fan.
2. Filters: One set of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 UNITARY ROOFTOP AIR CONDITIONERS

A. Manufacturers:

2. Lennox Industries Inc.; K Series/L Series.
3. Trane Company; a Division of Ingersoll Rand; Precedent and Voyager Light Commercial.
4. AAON, Inc.; RM Series.

B. Description: Factory assembled and tested; designed for exterior installation; consisting of compressor, condenser coil, direct expansion cooling coil, supply-air fan, condenser coil fan, refrigeration controls, filters, dampers, and temperature controls or interface specified for unit controls.

C. Maximum Temperature Distribution Across Supply Air Outlet:
1. 10 deg F Heating.
2. 5 deg F Cooling.

D. Casing: Galvanized-steel single-wall construction with enamel paint finish, hinged access doors with neoprene gaskets for inspection and access to internal parts, minimum 1/2-inch-thick thermal insulation, knockouts for electrical and piping connections, exterior condensate drain connection, and lifting lugs.

E. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1.
   1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
   2. Drain Connections: Threaded nipple.
   3. Pan-Top Surface Coating: Corrosion-resistant compound.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

G. Supply-Air Fan: Forward curved, centrifugal, belt driven with adjustable motor sheaves, grease-lubricated ball bearings, motor, and variable speed controller.

H. Condenser Coil Fan: Propeller type, directly driven by permanently lubricated motor.

I. Direct Expansion Cooling Coils: Aluminum-plate fin and seamless copper tube in steel casing with equalizing-type vertical distributor.

J. Compressor(s): Number as scheduled. Hermetic reciprocating or scroll compressors with integral vibration isolators, internal overcurrent and overtemperature protection, internal pressure relief, and crankcase heater(s).

K. Refrigeration System:
   1. Compressor(s).
   2. Condenser coil and fan.
   3. Direct expansion cooling coil and supply-air fan.
   4. Expansion valves with replaceable thermostatic elements.
   5. Check valves.
6. Refrigerant dryers.
7. High-pressure switches.
8. Low-pressure switches.
9. Thermostats for coil freeze-up protection during low-ambient temperature operation or loss of air.
10. Low ambient switch.
11. Brass service valves installed in discharge and liquid lines.
12. Independent refrigerant circuits.
13. Refrigerant: R-407C or R-410A.
15. Anti-recycling Timing Device: Prevents compressor restart for five minutes after shutdown.
16. Oil-Pressure Switch: Designed to shut down compressors on low oil pressure.

L. Filters: 2-inch-thick, fiberglass, pleated, throwaway filters in filter rack.

M. Heat Exchanger: Aluminized-steel or stainless-steel construction for natural-gas-fired burners. Units utilizing 50 percent or greater outside air must be stainless steel construction. Include the following controls:

2. Direct-spark pilot ignition.
3. Electronic flame sensor.
4. Induced-draft blower.
5. Flame rollout switch.

N. Outside-Air Damper: Linked damper blades with fully modulating, spring-return damper motor and hood.


P. Economizer: Return- and outside-air dampers with neoprene seals, bird screen, and hood.

1. Damper Motor: Fully modulating spring return with adjustable minimum position.
2. Control: Electronic-control system uses return-air and outside-air temperature to adjust mixing dampers.
3. Relief Fan: Static Pressure actuated with bird screen and hood.
Q. Electrical:

1. Factory-installed and -wired switches, motor controllers, transformers, and other electrical devices necessary shall provide a single-point field power connection.
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. Field power interface shall be to NEMA KS 1, heavy-duty, nonfused disconnect switch. Minimum SCCR according to UL 508 shall be as required by electrical power distribution system, but not less than 65,000 A.
5. Each motor shall have branch power circuit and controls with one of the following disconnecting means having SCCR to match main 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. UL 489, motor-circuit protector (circuit breaker) with field-adjustable, short-circuit trip coordinated with motor locked-rotor amperes.
6. Each motor shall have overcurrent protection.

R. Unit Controls: Solid-state control board and components contain at least the following features:

1. Supply-air fan control relay.
2. Default control to ensure proper operation after power interruption.
3. Field-adjustable control parameters.
4. Economizer control.
5. Electric heat staging.
7. Night setback mode (outside air damper lockout).
8. Low-refrigerant pressure control.
9. Control interface for BAS communication link.
S. Thermostat: Wall-mounted, programmable, electronic; with heating setback and cooling setup with seven-day programming; and the following:

1. Touch sensitive keypad.
2. Deg F space temperature readout.
3. LED indicators.
4. Hour/day programming.
6. Time and operational mode readout.
7. Status indicator.
8. Battery backup.
9. Subbase with manual system switch (on-heat-auto-cool) and fan switch (auto-on).

T. Conventional Thermostat Interface (BAS control or thermostat provided by others): For heating control, cooling control, occupied/unoccupied mode scheduling, and miscellaneous available status and alarm monitoring. Control interface details in accordance with temperature control system details indicated on the Drawings and specified in Division 15 Section “Temperature Controls.”

U. BAS Communication Link (with or without manufacturer provided thermostat): Install stand-alone control module providing link between unit controls and BAS. Control module shall be compatible with temperature-control system specified in Division 15 Section "Temperature Controls." Interface shall communicate the following:

1. Occupied (continuous) mode control.
2. Unoccupied cycle mode control.
3. Economizer mode activated.
4. Supply-air fan status.
5. Relief/Exhaust fan status.
6. Dirty filter alarm.
7. Specific unit alarms system diagnostics.
8. Occupied space heating and cooling setpoints.
9. Unoccupied space heating and cooling setpoints.
10. Unit monitored temperatures.
11. Control signal feedback (on/off or modulating signals).

V. Accessories:

2. Service Outlets: 115-V, ground-fault, circuit-interrupter type, field wired such that outlet remains energized even if the unit main disconnect is open.

3. Dirty-filter switch.

4. Hail guards of steel, painted to match casing.


W. Isolation Curb: Refer to Division 15 Section “Mechanical Vibration Controls.”

2.3 MOTORS

A. Comply with requirements in Division 15 Section "Motors."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hoist, transport, and rig air conditioning units or their shipping sections into position following procedures recommended by the manufacturer.

B. Install units level and plumb, maintaining manufacturer's recommended clearances. Install according to AHRI Guideline B.

C. Deliver roof curbs and equipment supports to site for installation under Division 07. Install rooftop air conditioners on equipment curbs and supports specified and as scheduled. Secure units to curb support with anchor bolts.

D. Unit Support: Install unit level on structural curbs. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections.

B. Install piping adjacent to machine to allow service and maintenance.
1. Gas Piping: Comply with applicable requirements in Division 15 Section "Fuel Gas Piping." Connect gas piping to burner, full size of gas train inlet, and connect with union and shutoff valve with sufficient clearance for burner removal and service.

C. Duct installation requirements are specified in other Division 15 Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

1. Install ducts to termination in roof curb.
2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
3. Connect supply ducts to rooftop unit with flexible duct connectors specified in Division 15 Section "Duct Accessories."
4. Terminate return-air duct through roof structure and insulate space between roof and bottom of unit with 2-inch-thick, acoustic duct liner.

D. Electrical System Connections: Comply with applicable requirements in Division 16 Sections for power wiring, switches, and motor controls.

E. Ground equipment according to Division 16 Section "Grounding and Bonding."

F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field quality-control tests and inspections and prepare test reports:

1. After installing rooftop air conditioners and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Repair malfunctioning units and retest as specified above; or remove malfunctioning units, replace with new units and retest as specified.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to furnace combustion chamber.
3. Inspect for visible damage to compressor, air-cooled outside coil, and fans.
4. Inspect internal insulation.
5. Verify that labels are clearly visible.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean outside coil and inspect for construction debris.
10. Clean furnace flue and inspect for construction debris.
11. Connect and purge gas line.
13. Inspect operation of barometric dampers.
14. Lubricate bearings on fan.
15. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
16. Adjust fan belts to proper alignment and tension.
17. Start unit according to manufacturer's written instructions.

   a. Start refrigeration system in summer only.
b. Complete startup sheets and attach copy with Contractor's startup report.

18. Inspect and record performance of interlocks and protective devices; verify sequences.
19. Operate unit for an initial period as recommended or required by manufacturer.
20. Perform the following operations for both minimum and maximum firing and adjust burner for peak efficiency. Adjust pilot to stable flame.
   a. Measure gas pressure on manifold.
   b. Measure combustion-air temperature at inlet to combustion chamber.
   c. Measure flue-gas temperature at furnace discharge.
   e. Measure supply-air temperature and volume when burner is at maximum firing rate and when burner is off. Calculate useful heat to supply air.
21. Check control interface wiring.
22. Adjust and inspect high-temperature limits.
23. Inspect outside-air dampers for proper stroke and interlock with return-air dampers.
24. Start refrigeration system and measure and record the following:
   a. Coil leaving-air, dry- and wet-bulb temperatures.
   b. Coil entering-air, dry- and wet-bulb temperatures.
   c. Outside-air, dry-bulb temperature.
   d. Outside-air-coil, discharge-air, dry-bulb temperature.
25. Inspect and verify operation of controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.
26. Measure and record the following minimum and maximum airflows.
   a. Supply-air volume.
   b. Return-air volume.
   c. Relief-air volume.
   d. Outside-air intake volume.
27. Simulate maximum cooling demand and inspect the following:
a. Compressor refrigerant suction and hot-gas pressures.
b. Short circuiting of air through outside coil or from outside coil to outside-air intake.

28. Record all final adjustment and control settings.
29. After startup and performance testing, change filters, vacuum heat exchanger and cooling and outside coils, lubricate bearings, adjust belt tension, and inspect operation of power vents.

3.5 ADJUSTING
A. Adjust initial temperature and humidity set points.
B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
C. 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 outside normal occupancy hours for this purpose, without additional cost.

3.6 DEMONSTRATION
A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain rooftop air conditioners.

END OF SECTION 15730
SECTION 15734 - COMPUTER-ROOM AIR-CONDITIONING UNITS

PART 1 - GENERAL

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

B. Related Sections include the following:
   1. Division 15 Section “Mechanical General Requirements.”
   2. Division 15 Section “Basic Mechanical Materials and Methods.”

1.2 SUBMITTALS
A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For computer-room air-conditioning units to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

B. ASHRAE Compliance:

1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."

2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Ventilation Rate Procedures," and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

D. ASME Compliance: Fabricate and label water-cooled condenser shell to comply with ASME Boiler and Pressure Vessel Code: Section VIII, "Pressure Vessels," Division 1.

1.4 COORDINATION

A. Coordinate layout and installation of computer-room air-conditioning units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate installation of computer-room air-conditioning units with computer-room access flooring Installer.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."
1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fan Belts: One set for each belt-drive fan.
2. Filters: One set of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply for product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 CEILING-MOUNTING UNITS (SPLIT-SYSTEM DX)

A. Manufacturers:

1. APC Network Air.
2. Data Aire Inc.

B. Description: Factory assembled split-system units with compressor located in remote condensing unit, and including cabinet, fan, filters, and controls, suitable for horizontal ceiling mounting with air distribution through integral grilles or ducted connections.

C. Cabinet: Galvanized steel with baked-enamel finish, insulated with 1/2-inch-thick duct liner.

1. Finish of Interior Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Evaporator Fan: Forward curved, centrifugal, and directly driven by two-speed motor.
1. Motor: Comply with requirements in Division 15 Section "Motors."

E. Evaporator Coil: Direct-expansion cooling coil of seamless copper tubes expanded into aluminum fins.

1. Mount coil assembly over stainless-steel drain pan complying with ASHRAE 62.1 and having a condensate pump unit with integral float switch, pump-motor assembly, and condensate reservoir.

F. Condensing Unit Cabinet: Steel with baked-enamel finish and containing compressor and condenser.

G. Remote Air-Cooled Condensing Unit: Copper-tube aluminum-fin coil with propeller fan, direct driven.

1. System shall have suction- and liquid-line compatible fittings and refrigerant piping for field interconnection.

H. Compressor: Scroll, with resilient suspension system, oil strainer, and internal motor overload protection.

1. Refrigeration Circuit: Low-pressure switch, manual-reset high-pressure switch, thermal-expansion valve with external equalizer, sight glass with moisture indicator, service shutoff valves, charging valves, and charge of refrigerant.

2. Refrigerant: R-410A.


I. Filter: 1-inch-thick, disposable, glass-fiber media.

J. Control System: Microprocessor based, unit-mounted panel with main fan contactor, compressor contactor, compressor start capacitor, control transformer with circuit breaker, solid-state temperature-and humidity-control modules, time-delay relay, reheat contactor, and high-temperature thermostat. Provide solid-state, wall-mounting control panel with start-stop switch, adjustable humidity set point, and adjustable temperature set point.

2.3 ACCESSORIES

A. Unit support curbs:
1. Manufacturers:
   a. Pate.
   b. ThyCurb.
   c. Roof Products & Systems.

2. Coordinate type and installation with Architectural trades. Top of support shall be level and extend a minimum of 8 inches above the top of the roof insulation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install computer-room air-conditioning units level and plumb, maintaining manufacturer's recommended clearances. Install according to ARI Guideline B.

B. Curb Support: Install and secure roof-mounting units on curbs and coordinate roof penetrations and flashing with roof construction. Secure units to curb support with anchor bolts.

C. Install suspended components level. Coordinate wall penetrations and flashing with wall construction. Secure units to structural support with anchor bolts.

D. Install air-cooled condenser on rubber-in-shear vibration isolators.

E. Support suspended units from structure using threaded steel rods and elastomeric hanger having 1-inch deflection. Vibration-control devices and installation requirements are specified in Division 15 Section "Mechanical Vibration Controls."

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.
C. Water and Drainage Connections: Comply with applicable requirements in Division 15 Section "Domestic Water Piping." Provide adequate connections for water-cooled units, condensate drain, and humidifier flushing system.

D. Refrigerant Piping: Comply with applicable requirements in Division 15 Section "Refrigerant Piping." Provide shutoff valves and piping.

E. Electrical System Connections: Comply with applicable requirements in Division 16 Sections for power wiring, switches, and motor controls.

F. Ground equipment according to Division 16 Section "Grounding and Bonding."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Inspect for and remove shipping bolts, blocks, and tie-down straps.
2. After installing computer-room air-conditioning units and after electrical circuitry has been energized, test for compliance with requirements.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
B. Verify that computer-room air-conditioning units are installed and connected according to manufacturer's written instructions and the Contract Documents.

C. Verify that electrical wiring installation complies with manufacturer's submittal and installation requirements in Division 16 Sections.

D. Complete installation and startup checks according to manufacturer's written instructions.

E. After startup service and performance test, change filters.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. 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 outside normal occupancy hours for this purpose, without additional cost.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain computer-room air-conditioning units. Refer to Division 15 Section "Mechanical General Requirements."

END OF SECTION 15734
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”
3. Division 15 Sections for coils that are integral to air-handling units.

1.2 SUMMARY

A. This Section includes duct-mounted heating coils, and heating coils that are an integral part of air-handling units.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each coil. Include rated capacity and pressure drop for each coil.
B. Shop Drawings: Diagram power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which coil location and ceiling-mounted access panels are shown and coordinated with each other.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For air coils to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance:

1. Comply with ASHRAE 15 for refrigeration system safety.
2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
3. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

PART 2 - PRODUCTS

2.1 WATER COILS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aerofin Corporation.
2. Carrier; a United Technologies Company.
3. Daikin Applied; a member of Daikin Industries, Ltd.
4. JCI/York International.
5. Luvata/Heatcraft Commercial/Industrial Products.
6. Precision Coils; a business of Unison Comfort Technologies.
7. Trane Inc.; a Division of Ingersoll Rand.

B. Performance Ratings: Tested and rated according to AHRI 410 and ASHRAE 33.
C. Minimum Working-Pressure/Temperature Ratings: 200 psig, 325 deg F.

D. Source Quality Control: Factory tested to 300 psig.

E. Tubes: ASTM B 743 copper, minimum 0.020 inch wall thickness, and minimum 0.50 inch diameter.

F. Fins: Aluminum, minimum 0.010 inch thick.

G. Headers: Cast iron with cleaning plugs, and drain and air vent tappings or seamless copper tube with brazed joints, prime coated.

H. Frames, Hot Water Coils: Galvanized-steel channel frame, minimum 0.0625 inch thick for flanged mounting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine ducts, plenums, and casings to receive air coils for compliance with requirements for installation tolerances and other conditions affecting coil performance.

B. Examine roughing-in for piping systems to verify actual locations of piping connections before coil installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install coils level and plumb.

B. Install coils in metal ducts and casings constructed according to SMACNA's "HVAC Duct Construction Standards, Metal and Flexible."

C. Straighten bent fins on air coils.

D. Clean coils using materials and methods recommended in writing by manufacturers, and clean inside of casings and enclosures to remove dust and debris.
3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to coils to allow service and maintenance.

C. Connect water piping with unions and shutoff valves to allow coils to be disconnected without draining piping. Control valves are specified in Division 15 Section "Temperature Controls," and other piping specialties are specified in Division 15 Section "Hydronic Piping."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, operate electric coils to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

END OF SECTION 15761
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”

1.2 SUMMARY

A. This Section includes propeller fan unit heaters with hot-water electric-resistance coils.
1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit type and configuration.

B. Shop Drawings: Submit the following for each unit type and configuration:
   1. Plans, elevations, sections, and details.
   2. Details of anchorages and attachments to structure and to supported equipment.
   4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.

C. Coordination Drawings: Plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Suspended ceiling components.
   2. Structural members to which unit heaters will be attached.
   3. Other items, including the following:
      a. Lighting fixtures.
      b. Sprinklers.
      c. Ductwork.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hot-Water Unit Heaters:
   a. Daikin Applied; a member of Daikin Industries, Ltd.
   b. Dunham-Bush, Inc.
   c. Hydro-Air Components; Rittling.
   d. Modine Manufacturing Co.
   e. Sterling Radiator, a Mestek Company.
   f. Trane Inc.; a Division of Ingersoll Rand.
   g. Vulcan Radiator, a Mestek Company.

2. Electric Unit Heaters:
   a. Brasch Manufacturing Co.
   b. Chromalox, Inc.; a division of Emerson Electric Company.
   c. Electra Tek Corp.
   d. Indeeco.
   e. Markel Products; a division of TPI Corporation.
   f. Sterling Radiator; a Mestek Company.
   g. Trane Inc.; a Division of Ingersoll Rand.

2.2 UNIT HEATERS

A. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

B. Comply with UL 2021.

C. Comply with UL 823.

2.3 CASING

A. Cabinet: Removable panels for maintenance access to controls.
B. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Discharge Louver: Four-way adjustable louvers for horizontal units and adjustable pattern diffuser for projection units.

2.4 COILS

A. Test and rate hot-water propeller unit-heater coils according to ASHRAE 33.

B. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

2.5 ELECTRIC-RESISTANCE HEATING ELEMENTS

A. Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in steel or corrosion-resistant metallic sheath with fins no closer than 0.16 inch. Element ends shall be enclosed in terminal box. Fin surface temperature shall not exceed 550 deg F at any point during normal operation.

2. Wiring Terminations: Stainless-steel or corrosion-resistant material.

2.6 FAN

A. Propeller type, aluminum wheel directly mounted on motor shaft in the fan venturi.

2.7 FAN MOTORS

A. Comply with requirements in Division 15 Section "Motors."
B. Motor Type: Permanently lubricated.

2.8 CONTROLS

A. Control Devices:

1. Unit-mounted thermostat.

2.9 CAPACITIES AND CHARACTERISTICS

A. Refer to Schedule on Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive propeller unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before propeller unit-heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install propeller unit heaters level and plumb.

B. Install propeller unit heaters to comply with NFPA 90A.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers. Hanger rods and attachments to structure are specified in Division 15 Section "Hangers and Supports." Vibration hangers are specified in Division 15 Section "Mechanical Vibration Controls."

D. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls.
3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Comply with safety requirements in UL 1995.

D. Hot Water Piping: Unless otherwise indicated:
   1. Install union and isolation valve on supply-water connection.
   2. Install union and calibrated balancing valve or PICCV as indicated on the Drawings on return-water connection.
   3. Hydronic specialties are specified in Division 15 Section "Hydronic Piping."

E. Ground equipment according to Division 16 Section "Grounding and Bonding."

F. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing and report results in writing:
   1. After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
   3. Test and adjust controls and safeties.

B. Remove and replace malfunctioning units and retest as specified above.
3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain propeller fan unit heaters. Refer to Division 15 Section "Mechanical General Requirements."

END OF SECTION 15767
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”

1.2 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Plans, elevations, sections, and details.
2. Location and size of each field connection.
3. Location and arrangement of piping valves and specialties.
4. Location and arrangement of integral controls.

C. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which cabinet unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.

6. Perimeter moldings for exposed or partially exposed cabinets.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For cabinet unit heaters to include in operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1-2004 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."
1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: Furnish spare filter for each filter installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Carrier Corporation; United Technologies Corporation.
2. Daikin Applied; a member of Daikin Industries, Ltd.
3. Hydro-Air Components Inc.; Rittling.
5. Sterling Radiator; a Mestek Company.
6. Trane; a business of Ingersoll Rand.
7. Vulcan Radiator; a Mestek Company.

B. Description: A factory-assembled and -tested unit complying with AHRI 440.

C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall have erosion-resistant coating to prevent erosion of glass fibers.

1. Thickness: Minimum 1/2 inch.
2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Cabinet: Steel with baked-enamel finish with manufacturer's standard paint, in color selected by Architect.
1. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch-thick, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.

2. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch-thick, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.

3. Recessing Flanges for Units That Are Semirecessed or Fully Recessed: Steel, finished to match cabinet.

4. Control Access Door: Key operated.

5. Base for Surface, Vertical, Wall-Mounting Units: Minimum 0.0528-inch-thick steel, finished to match cabinet, 6 inches high with leveling bolts.

E. Filters: Minimum arrestance according to ASHRAE 52.1 and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

   1. Glass Fiber Treated with Adhesive: Throw-away type 80 percent arrestance and 5 MERV.

F. Hot-Water Coil: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

G. Fan and Motor Board: Removable.

   1. Fan: Forward curved, double-width centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.

   2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 15 Section "Motors."

   3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

H. Electrical Connection: Factory wire motors and controls for a single field connection.

I. Capacities and Characteristics: Refer to Schedule on Drawings.
2.2 UNIT CONTROLS

A. Control devices are specified in Division 15 Section "Temperature Controls," and operational sequences are indicated on the Drawings.

B. Basic Unit Controls:

1. Control voltage transformer.
2. Wall-mounting thermostat with the following features.
   b. Fan on-auto switch.
   d. Adjustable deadband.
   e. Concealed set point.
   f. Concealed indication.
   g. Deg F indication.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive cabinet unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before cabinet unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install cabinet unit heaters to comply with NFPA 90A.

B. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Division 15 Section "Mechanical Vibration Controls."

C. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.
D. Install new filters in each fan-coil unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 15 Section "Duct Accessories."

D. Comply with safety requirements in UL 1995.

E. Ground equipment according to Division 16 Section "Grounding and Bonding."

F. Connect wiring according to Division 16 Section "Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

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.

C. Remove and replace malfunctioning units and retest as specified above.
3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters.
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section "Mechanical General Requirements."
2. Division 15 Section "HVAC Casings" for factory- and field-fabricated casings for mechanical equipment.
3. Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 SUMMARY

A. This Section includes metal ducts for supply, return, outside, relief air, and exhaust air-distribution systems.

B. Products Installed but Not Furnished Under This Section:

1. Receive, handle, and install terminal boxes furnished by the Laboratory Airflow Controls Contractor. Refer to Division 15 Section "Laboratory Airflow Controls."

1.3 DEFINITIONS

A. Duct Sizes: Inside clear dimensions. For lined ducts, maintain sizes inside lining.

B. Low Pressure: Up to and including 2 inch WG and velocities less than 1,500 fpm.

C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm.

D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm.

E. FRP: Fiberglass-reinforced plastic.

F. PVC: Polyvinyl Chloride.

1.4 SYSTEM DESCRIPTION

A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.5 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 Application Schedule" Article.

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.6 SUBMITTALS

A. Shop Drawings: Drawn to scale. Show fabrication and installation details for metal ducts. Shop drawings shall be reviewed and approved by the Architect prior to any fabrication.

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Duct layout indicating sizes and pressure classes.
3. Elevations of top and bottom of ducts.
4. Dimensions of main duct runs from building grid lines.
5. Fittings.
6. Reinforcement and spacing.
7. Seam and joint construction.
8. Penetrations through fire-rated and other partitions.
9. Equipment installation based on equipment being used on Project.
10. Duct accessories, including access doors and panels.
11. Hangers and supports, including methods for duct and building attachment, vibration isolation.

B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Other systems installed in same space as ducts.
3. Ceiling- and wall-mounting access doors and panels required to provide access to dampers and other operating devices.
4. Ceiling-mounting items, including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Welding certificates.
D. Field quality-control test reports.

1.7 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:


B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

D. NFPA Compliance:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."


F. Duct Liner Maximum Temperature Limits: Based on ASTM C 411 test procedures.

1.8 COORDINATION

A. Sheet metal trades shall cooperate fully with the Laboratory Airflow Controls Trades and shall attend all field installation training sessions.

B. Sheet metal trades shall cooperate fully with the Test and Balance Contractor and provide all miscellaneous caps and any other materials required for structural integrity and leakage testing of the complete duct system in whole or in
part. Refer to Division 15 Section "Testing, Adjusting and Balancing."

1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.

C. Sheet metal trades shall participate in the above ceiling coordination program. Refer to Division 01 requirements.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. 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.


C. Reinforcement Shapes and Plates:

1. Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
2. Compatible materials for aluminum and stainless-steel ducts.

D. Tie Rods:

2. Ducts in Humid or Corrosive Atmospheres: Stainless steel, 1/4-inch diameter for lengths 36 inches or
less; 3/8-inch diameter for lengths longer than 36 inches.

2.3 SEALANTS AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Elastomeric Sealant Tape: 3 inches wide; modified butyl adhesive backed.
   1. Manufacturers:
      a. Hardcast; Foil-Grip 1402 and Foil-Grip 1402-181BFX.

C. Water-Based Joint and Seam Sealant:
   1. Manufacturers:
      a. Hardcast; Flex-Grip 550 and Versa-Grip 181.
      b. Polymer Adhesives; No. 11.
      c. United McGill.
   5. Water resistant.
   6. Mold and mildew resistant.
   7. VOC: Maximum 75 g/L (less water).
   8. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Solvent-Based Joint and Seam Sealant:
   1. Manufacturers:
      a. Hardcast; Sure-Grip 404.
      b. United McGill.
5. Solids Content: Minimum 60 percent.
7. Water resistant.
8. Mold and mildew resistant.
9. VOC: Maximum 395 g/L.
10. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
11. Service: Indoor or outdoor.

E. Flanged Joint Sealant: Comply with ASTM C 920.

2. Type: S.
3. Grade: NS.
5. Use: O.

F. Gaskets: Chloroprene elastomer, 40 durometer, 1/8 inch thick, full face, one piece vulcanized or dovetailed at joints.

G. 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.

2.4 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.

2. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.


E. Load Rated Cable Suspension System for Noncorrosive Environments: Tested to five times the Safe Working Loads and verified by the SMACNA Testing and Research Institute.

1. Cable: Aircraft quality 7 x 7 and 7 x 19 wire rope.


2. Fastener: One-piece, die-cast zinc housing with Type 302 S26 stainless steel hardened and tempered springs, and oil impregnated, sintered, hardened and tempered steel locking wedges.

3. End Fixings: Loop, stud or toggle; or plain end suitable for wire rope beam clamp.

4. Manufacturers:

   b. Duro Dyne Corp.; Dyna-Tite System.

F. Welded Supports: Structural steel shapes with zinc rich paint. Equivalent, proprietary design, rolled steel structural support systems may be used in lieu of mill rolled structural steel.
2.5 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
3. Internal Tie Rods: As allowed by SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's and SMACNA guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Nexus Inc.
   c. Ward Industries, Inc.

C. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

2.6 ROUND AND FLAT-OVAL DUCT AND FITTING FABRICATION

A. Diameter as applied to flat-oval ducts in this Article is the diameter of a round duct with a circumference equal to the perimeter of a given size of flat-oval duct.

B. Round and Flat-Oval, Spiral Lock-Seam Ducts:

1. Manufacturers:
   a. Eastern Sheet Metal (ESM).
   b. LaPine Metal Products.
c. Linx Industries (previously Lindab USA); a DMI Company.
e. SEMCO Incorporated.
f. SET Duct Manufacturing, Inc.
g. Tangent Air, Inc.
h. Universal Spiral Air.

C. Round, Spiral Lock-Seam Ducts: Fabricate supply ducts of galvanized steel according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA "Industrial Duct Construction Standards" as required based on pressure class.

1. Round fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.

D. Flat-Oval, Spiral Lock-Seam Ducts: Fabricate supply ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" or SMACNA "Industrial Duct Construction Standards" as required based on pressure class.

1. Flat-oval fittings shall be factory fabricated welded design. Use of field fabricated fittings (welded design) shall only be permitted when factory fabricated fittings are unavailable.

E. Duct Joints:

1. Ducts up to 20 Inches in Diameter: Interior, center-beaded slip coupling, sealed before and after fastening, attached with sheet metal screws.
2. Ducts 21 to 72 Inches in Diameter: Three-piece, gasketed, flanged joint consisting of two internal flanges with sealant and one external closure band with gasket.
3. Ducts Larger Than 72 Inches in Diameter: Companion angle flanged joints per SMACNA "HVAC Duct Construction Standards--Metal and Flexible," Figure 3-2.
5. Round Ducts: Prefabricated connection system consisting of double-lipped, EPDM rubber gasket. Manufacture ducts according to connection system manufacturer's tolerances.

a. Manufacturers:

1) AccuDuct Mfg. Inc.
2) Ductmate Industries, Inc.
3) Eastern Sheet Metal (ESM).
4) Linx Industries (previously Lindab USA); a DMI Company.
5) Universal Spiral Air.

6. Flat-Oval Ducts: Prefabricated connection system consisting of two flanges and one synthetic rubber gasket.

a. Manufacturers:

1) AccuDuct Mfg. Inc.
2) Ductmate Industries, Inc.
3) Eastern Sheet Metal (ESM).
4) Linx Industries (previously Lindab USA); a DMI Company.
6) SEMCO Incorporated.
7) Universal Spiral Air.

F. Low Pressure Ductwork (plus or minus 2 inches W.G. Static Pressure Class)

1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible provide single thickness turning vanes.

2. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.

G. Medium and High Pressure Ductwork (For Static Pressure Class Greater than plus or minus 2 inches W.G.)

1. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline.
Where not possible provide single thickness turning vanes.

2. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

3. Fabricate continuously welded medium and high pressure round and oval duct fittings two gauges heavier than duct gauges indicated in SMACNA Standard. Joints shall be minimum 4 inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

4. Provide standard 45 degree lateral wye takeoffs unless otherwise indicated where 90 degree conical tee connections may be used.

H. 90-Degree Tees and Laterals and Conical Tees: Fabricate to comply with SMACNA’s "HVAC Duct Construction Standards--Metal and Flexible," with metal thicknesses specified for longitudinal-seam straight ducts.

I. Diverging-Flow Fittings: Fabricate with reduced entrance to branch taps and with no excess material projecting from fitting onto branch tap entrance.

J. Fabricate elbows using die-formed, gored, pleated, or mitered construction. Bend radius of die-formed, gored, and pleated elbows shall be 1-1/2 times duct diameter. Unless elbow construction type is indicated, fabricate elbows as follows:

1. Mitered-Elbow Radius and Number of Pieces: Welded construction complying with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

2. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from minus 2- to plus 2-inch wg:

   a. Ducts 3 to 36 Inches in Diameter: 0.034 inch.
   b. Ducts 37 to 50 Inches in Diameter: 0.040 inch.
   c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
   d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

3. Round Mitered Elbows: Welded construction with the following metal thickness for pressure classes from 2- to 10-inch wg:

   a. Ducts 3 to 26 Inches in Diameter: 0.034 inch.
   b. Ducts 27 to 50 Inches in Diameter: 0.040 inch.
c. Ducts 52 to 60 Inches in Diameter: 0.052 inch.
d. Ducts 62 to 84 Inches in Diameter: 0.064 inch.

4. Flat-Oval Mitered Elbows: Welded construction with same metal thickness as longitudinal-seam flat-oval duct.

5. 90-Degree, 2-Piece, Mitered Elbows: Use only for supply systems or for material-handling Class A or B exhaust systems and only where space restrictions do not permit using radius elbows. Fabricate with single-thickness turning vanes.

6. Round Elbows 8 Inches and Less in Diameter: Fabricate die-formed elbows for 45- and 90-degree elbows and pleated elbows for 30, 45, 60, and 90 degrees only. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

7. Round Elbows 9 through 14 Inches in Diameter: Fabricate gored or pleated elbows for 30, 45, 60, and 90 degrees unless space restrictions require mitered elbows. Fabricate nonstandard bend-angle configurations or nonstandard diameter elbows with gored construction.

8. Round Elbows Larger Than 14 Inches in Diameter and All Flat-Oval Elbows: Fabricate gored elbows unless space restrictions require mitered elbows.

9. Die-Formed Elbows for Sizes through 8 Inches in Diameter and All Pressures 0.040 inch thick with 2-piece welded construction.

10. Round Gored-Elbow Metal Thickness: Same as non-elbow fittings specified above.

11. Flat-Oval Elbow Metal Thickness: Same as longitudinal-seam flat-oval duct specified above.

12. Pleated Elbows for Sizes through 14 Inches in Diameter and Pressures through 10-Inch wg: 0.022 inch.

PART 3 - EXECUTION

3.1 DUCTWORK APPLICATION SCHEDULE

A. Ductwork materials and performance requirements are scheduled on the Drawing.

3.2 DUCTWORK APPLICATION SCHEDULE

A. Refer to application schedule on the Drawing.
3.3 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install round and flat-oval ducts in lengths not less than 12 feet unless interrupted by fittings.

C. Install ducts with fewest possible joints.

D. Install fabricated fittings for changes in directions, size, and shape and for connections.

E. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

F. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Conceal ducts from view in finished spaces. Do not encase horizontal runs in solid partitions unless specifically indicated.

J. Coordinate layout with suspended ceiling, fire- and smoke-control dampers, lighting layouts, and similar finished work.

K. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

L. Electrical Equipment Spaces: Route ducts to avoid passing through transformer vaults and electrical equipment spaces and enclosures.
M. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

N. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, and sleeves. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories."
   1. Where ducts not having fire dampers, smoke dampers, or combination fire and smoke dampers pass through fire-rated partitions, maintain indicated fire rating. Seal penetrations with firestop materials. Refer to Division 07 Specification Sections for materials and UL classified firestop systems.

O. Protect duct interiors from moisture, construction debris and dust, and other foreign materials.

   1. Intermediate level.

3.4 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.

3.5 DUCT SEALING

A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated. Ducts must be properly cleaned and sealed in strict accordance with sealant manufacturer’s instructions.

1. Seal Class: Refer to Application Schedule on the Drawings.
2. Seal ducts before external insulation is applied.
3. After pressure testing, remake leaking joints until leakage is equal to or less than maximum allowable. Refer to Application Schedule on the Drawings for allowable leakage rates.

3.6 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet and at each floor.

C. Support ductwork from building structure, not from roof deck, floor slab, pipe, other ducts, or equipment.

D. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

E. Use load rated cable suspension system for round duct in exposed locations.

3.7 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 15 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.
3.8 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.9 FIELD QUALITY CONTROL

A. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible contaminants are present.

B. Duct system will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.10 START UP

A. Air Balance: Comply with requirements in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION 15815
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Testing, Adjusting, and Balancing” for duct test holes.
3. Division 15 Section “Temperature Controls” for motorized control dampers.
4. Division 16 Section "Fire Alarm" for duct-mounting fire and smoke detectors.

1.2 DEFINITIONS

A. NVLAP: National Voluntary Laboratory Accreditation Program.

B. Low Pressure: Up to 2 inch WG and velocities less than 1,500 fpm. Construct for 2 inch WG positive or negative static pressure.

C. Medium Pressure: Greater than 2 inch WG to 6 inch WG and velocities greater than 1,500 fpm and less than 2,500 fpm. Construct for 6 inch WG positive or negative static pressure.

D. High Pressure: Greater than 6 inch WG to 12 inch WG and velocities greater than 2,500 fpm. Construct for 12 inch WG positive or negative static pressure.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

1. For turning vanes, include data for pressure loss generated sound power levels.
2. For duct silencers, include pressure drop and dynamic insertion loss data.

B. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

   a. Special fittings.
   c. Control damper installations.
   d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale and coordinating penetrations and ceiling-mounting items. Show ceiling-mounting access panels and access doors required for access to duct accessories.

D. Source quality-control reports.

E. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE


B. Comply with AMCA 500-D testing for damper rating.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed for each temperature rating.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SHEET METAL MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for acceptable materials, material
thickmesses, and duct construction methods, unless otherwise indicated.

B. Galvanized Sheet Steel: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.


2.3 LOW PRESSURE MANUAL VOLUME DAMPERS

A. Manufacturers:

1. American Warming and Ventilating.
2. Arrow United Industries.
5. Louvers and Dampers.
6. Nailor Industries Inc.
7. Ruskin Company.
8. Vent Products Company, Inc.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

1. Except for dampers in round ductwork sized 12 inches and smaller, provide end bearings.

C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design AMCA certified for maximum
leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications.

F. Damper Materials:

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch-thick, galvanized sheet steel.
4. Bearings: Oil-impregnated bronze, molded synthetic, or stainless-steel sleeve type.
5. Tie Bars and Brackets: Galvanized steel.

G. Jackshaft: 1-inch-diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

H. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.4 MEDIUM OR HIGH PRESSURE MANUAL VOLUME DAMPERS

A. Manufacturers:

1. American Warming and Ventilating.
2. Greenheck.
3. Louvers and Dampers.
4. Nailor Industries Inc.
5. Ruskin Company.

B. General Description: Factory fabricated, galvanized steel or extruded aluminum construction, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations
C. Rectangular Volume Dampers: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications. Construction and assembly such that no noise producing blade vibration occurs at velocities 20 percent greater than maximum system design velocity.

D. Round Volume Dampers 16-inch Diameter and Smaller: Single-blade, or multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications. Construction and assembly such that no noise producing blade vibration occurs at velocities 20 percent greater than maximum system design velocity.

E. Round Volume Dampers Larger than 16-inch Diameter: Multiple-opposed-blade design, AMCA certified for maximum leakage of 2 percent of total fan volume at shutoff, and suitable for horizontal or vertical applications. Construction and assembly such that no noise producing blade vibration occurs at velocities 20 percent greater than maximum system design velocity.

F. Damper Materials:

1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch-thick, galvanized sheet steel.
3. Aluminum Frames: Hat-shaped, 0.10-inch-thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
4. Extruded-Aluminum Blades: 0.050-inch-thick extruded aluminum.
5. Blade Axles: Galvanized steel or stainless steel.
7. Tie Bars and Brackets: Aluminum or galvanized steel.
G. Jackshaft: 1-inch-diameter, galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.

1. Length and Number of Mountings: Appropriate to connect linkage of each damper in multiple-damper assembly.

H. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.5 MOTORIZED CONTROL DAMPERS

A. Refer to Division 15 Section “Temperature Controls.”

2.6 FIRE DAMPERS (CURTAIN STYLE)

A. Manufacturers:

1. Air Balance, Inc.
2. Greenheck.
3. NCA Manufacturing, Inc.
4. Nailor Industries Inc.
5. Ruskin Company.

B. Dynamic fire dampers with curtain style blades, and labeled according to UL 555, maximum velocity 2000 fpm, maximum static pressure 4 inches w.g.

C. Fire Rating:

1. 1-1/2 hours for 2 hour rated walls.
2. 3 hours for 4 hour rated walls.

D. Frame: Type B or Type C Curtain type with blades outside airstream; fabricated with roll-formed, galvanized steel in gages required by manufacturer’s UL listing; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch- thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch- thick, galvanized-steel blade connectors.

H. Fusible Links: Replaceable, 165 deg F rated.

2.7 FIRE DAMPERS (MULTIPLE BLADE TYPE)

A. Manufacturers:

1. Greenheck.
2. NCA Manufacturing, Inc.
3. Nailor Industries Inc.
4. Ruskin Company.

B. Dynamic fire dampers with multiple blades, and labeled according to UL 555, maximum velocity of 2000 fpm, maximum static pressure 4 inches w.g.

C. Fire Rating:

1. 1-1/2 hours for 2 hour rated walls.
2. 3 hours for 4 hour rated walls.

D. Frame: Fabricated with roll-formed, galvanized steel in gages required by manufacturer’s UL listing; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.

1. Thickness: Equal to or thicker than the duct connected to it, and of length to suit application.
2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.
G. Blades: Parallel operation, single-piece airfoil type construction with 0.078 inch equivalent thickness, or 0.064 inch thick, roll-formed, triple v-groove.

H. Axles: 1/2 inch plated steel hex.

I. Bearings: Oil-impregnated bronze sleeve type, pressed into frame.

J. Linkage: Concealed in frame.

K. Fusible Links: Replaceable, 165 deg F rated.

2.8 DUCT SILENCERS (FIBERGLASS FILL)

A. Manufacturers:

1. Industrial Acoustics Co. Inc.
2. Price Industries.
3. Ruskin Company.
4. VAW Systems Ltd.
5. Vibro-Acoustics.

B. General Requirements:

1. Factory fabricated.
2. Fire-Performance Characteristics: Adhesives, sealants, packing materials, and accessory materials shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84.
3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Rectangular Units: Unless otherwise scheduled on the Drawings, fabricate casings with a minimum of 20 gage, solid galvanized sheet metal for outer casing and 22 gage, ASTM A 653/A 653M, G90, perforated galvanized sheet metal for inner casing.

D. Round Units: Unless otherwise scheduled on the Drawings:

1. Outer Casings:
   b. Up to 8 Inches in Diameter: 24 gage.
c. 9 through 22 Inches in Diameter: 22 gage.
d. 24 through 36 Inches in Diameter: 20 gage.
e. 38 through 50 Inches in Diameter: 18 gage.
f. 52 through 60 Inches in Diameter: 16 gage.
g. Casings fabricated of spiral lock-seam duct may be
   one gage thinner than that indicated.
2. Interior Casing, Partitions, and Baffles:
   b. At least 24 gage thick and designed for minimum
      aerodynamic losses.

E. Sheet Metal Perforations: 1/8-inch diameter for inner
   casing and baffle sheet metal.

F. Fill Material: Inert and vermin-proof fibrous glass
   material, packed under not less than 5 percent
   compression.
   1. Erosion Barrier: Mylar film with 1/4-inch standoff.
      a. Return fan inlet and outlet silencer fill shall
         not be encapsulated in Mylar.

G. Fabricate silencers to form rigid units that will not
   pulsate, vibrate, rattle, or otherwise react to system
   pressure variations.
   1. Do not use nuts, bolts, or sheet metal screws for unit
      assemblies.
   2. Lock form and seal or continuously weld joints.
   3. Suspended Units: Factory-installed suspension hooks or
      lugs attached to frame in quantities and spaced to
      prevent deflection or distortion.
   4. Reinforcement: Cross or trapeze angles for rigid
      suspension.

H. Source Quality Control:
   1. Acoustic Performance: Test according to ASTM E 477.
      a. Tests performed in NVLAP accredited laboratory.
      b. Include accreditation certificate with submittals.
      c. Submittals from non-NVLAP accredited facilities
         will not be accepted.
2. Record acoustic ratings, including dynamic insertion loss and self-noise power levels with an airflow of at least 2000-fpm face velocity.

3. Leak Test: Test units for airtightness at 200 percent of associated fan static pressure or 6-inch wg static pressure, whichever is greater.

2.9 TURNING VANES

A. Manufactured Turning Vanes:

1. Comply with SMACNA’s "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

2. Double-vane or airfoil-shaped, curved blades of galvanized sheet steel set into vane runners suitable for duct mounting.

3. Generated sound power level shall not exceed 54 decibels in octave band 4 at 2000 fpm in a 24-inch by 24-inch duct.

4. Manufacturers:
   b. Ductmate Industries, Inc.
   c. Duro Dyne Corp.
   d. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Acoustic Turning Vanes:

1. Comply with SMACNA’s "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

2. Double-vane curved blades of galvanized sheet steel with perforated faces and fibrous-glass fill set into vane runners suitable for duct mounting.

3. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

2.10 REMOTE DAMPER OPERATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Pottorff; a division of PCI Industries, Inc.
2. Ventfabrics, Inc.
3. Young Regulator Company.

B. Description: Cable system designed for remote manual damper adjustment.

C. Tubing: Brass.

D. Cable: Stainless steel.

E. Wall-Box Mounting: Recessed, 2 inches deep.

F. Wall-Box Cover-Plate Material: Steel.

2.11 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class. Doors may be field fabricated in accordance with SMACNA Standards, or commercially produced.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

1. Manufacturers:
   a. Air Balance, Inc.
   b. Greenheck.
   c. Nailor Industries Inc.
   d. Ruskin Company.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

3. Provide number of hinges and locks as follows:
   a. Less Than 12 Inches Square: Secure with two sash locks.
   b. Up to 18 Inches Square: Two hinges and two compression locks.
   c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
   d. Sizes 24 by 48 Inches and Larger: One additional hinge.
C. Door: Double wall, duct mounting, and round; fabricated of galvanized sheet metal with insulation fill and 1-inch thickness. Include cam latches.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Flexmaster U.S.A., Inc.

2. Frame: Galvanized sheet steel, with spin-in notched frame.

D. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

E. Insulation: 1-inch-thick, fibrous-glass or polystyrene-foam board.

2.12 FLEXIBLE CONNECTORS

A. Manufacturers:

1. ADSCO Manufacturing LLC.
2. Duro Dyne Corp.
3. Senior Flexonics Pathway.
4. Ventfabrics, Inc.
5. Ductmate Industries, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class I.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip minimum 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.


1. Minimum Weight: 26 oz./sq. yd.
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 20 to plus 200 deg F.
2.13 FLEXIBLE DUCTS, LOW AND MEDIUM PRESSURE

A. Manufacturers:

1. Flexmaster U.S.A., Inc.; a Masterduct Company; Type 1M Acoustical.
3. Thermaflex; part of the Flexible Technologies Group.

B. Insulated Flexible Ducts: UL 181, Class 1, flexible duct wrapped with flexible glass fiber insulation, enclosed by a fire retardant polyethylene vapor barrier jacket; maximum 0.23 K value at 75 deg F.

C. Acoustical performance tested in accordance with the Air Diffusion Council's Flexible Air Duct Test Code FD 72-R1, Section 3.0, Sound Properties shall be as follows:

The insertion loss (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

<table>
<thead>
<tr>
<th>Octave Band Hz.</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>6&quot; diameter</td>
<td>125</td>
<td>250</td>
<td>500</td>
<td>1000</td>
<td>2000</td>
<td>4000</td>
</tr>
<tr>
<td>8&quot; diameter</td>
<td>13</td>
<td>32</td>
<td>36</td>
<td>35</td>
<td>39</td>
<td>25</td>
</tr>
<tr>
<td>12&quot; diameter</td>
<td>15</td>
<td>29</td>
<td>28</td>
<td>33</td>
<td>26</td>
<td>14</td>
</tr>
</tbody>
</table>

The radiated noise reduction (dB) of a 10 foot length of straight duct when tested in accordance with ASTM E477, at a velocity of 2500 feet per minute, shall be minimum:

<table>
<thead>
<tr>
<th>Octave Band Hz.</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>6&quot; diameter</td>
<td>6</td>
<td>8</td>
<td>7</td>
<td>8</td>
<td>9</td>
<td>13</td>
</tr>
<tr>
<td>8&quot; diameter</td>
<td>9</td>
<td>6</td>
<td>6</td>
<td>7</td>
<td>8</td>
<td>10</td>
</tr>
<tr>
<td>12&quot; diameter</td>
<td>9</td>
<td>7</td>
<td>6</td>
<td>6</td>
<td>8</td>
<td>11</td>
</tr>
</tbody>
</table>

The self-generated sound power levels (LW) dB are 10-12 Watt of a 10 foot length of straight duct for an empty sheet metal duct when tested in accordance with ASTM E477, at a velocity of 1000 feet per minute, shall not exceed:

<table>
<thead>
<tr>
<th>Octave Band Hz.</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
<td>6&quot; diameter</td>
<td>42</td>
<td>31</td>
<td>23</td>
<td>18</td>
<td>17</td>
<td>21</td>
</tr>
<tr>
<td>8&quot; diameter</td>
<td>41</td>
<td>34</td>
<td>27</td>
<td>19</td>
<td>18</td>
<td>21</td>
</tr>
<tr>
<td>12&quot; diameter</td>
<td>53</td>
<td>44</td>
<td>36</td>
<td>27</td>
<td>21</td>
<td>22</td>
</tr>
</tbody>
</table>

D. Flexible Duct Fittings: Galvanized steel, twist-in design with damper. Size as indicated.
2.14 FLEXIBLE DUCT ELBOW SUPPORTS

A. Manufacturer:
   1. Thermaflex; part of the Flexible Technologies Group; FlexFlow Elbow.
   2. Smart Air & Energy Solutions; SMART Flow Elbow.

B. Elbow supports shall be constructed of durable composite material and be fully adjustable to support flexible duct diameters 6 inches through 16 inches.

C. Elbow supports shall be UL listed for use in return air plenum spaces.

2.15 DUCT ACCESSORY HARDWARE

A. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts and PVC coated ducts; and aluminum accessories in aluminum ducts.

C. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install stainless steel volume dampers in stainless steel ducts.
   3. Install aluminum volume dampers in aluminum ducts.
D. Set dampers to fully open position before testing, adjusting, and balancing.

E. Install fire dampers according to UL listing.

F. Install duct silencers rigidly to ducts.

G. Install duct access doors on ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. On upstream side of duct coils.
2. Upstream from duct filters.
3. At outdoor-air intakes and mixed-air plenums.
4. At drain pans.
5. Downstream from control dampers, backdraft dampers, and duct mounted equipment.
6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links.
7. Control devices requiring inspection, including airflow measuring devices. Size access doors appropriately to facilitate service of each device.
8. Elsewhere as indicated.

H. Install access doors with swing against duct static pressure.

I. Install duct-mounting, rectangular access doors with long dimension at right angles to direction of airflow and of largest standard size which can be accommodated in duct. Maximum size: 21 by 14 inches.

J. Label access doors according to Division 15 Section "Mechanical Identification."

K. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

L. For fans developing static pressures of 5-inch wg and higher, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Connect terminal units to supply ducts directly or with maximum 12-inch lengths of flexible duct. Do not use flexible ducts to change directions.
N. Connect diffusers or linear diffuser boots to low pressure ducts flexible duct clamped or strapped in place.

O. Connect flexible ducts to metal ducts with draw bands.

P. Install flexible duct elbow supports at each diffuser, grille, or register, and elsewhere as indicated.

Q. Install turning vanes in rectangular duct elbows in excess of 45 degrees, and where indicated:
   1. Use manufactured double-vane turning vanes unless otherwise specified.
   2. Seat outboard-most vane in heal of duct elbow.
   3. Provide vanes for all runner punchings, practice of eliminating every other vane is prohibited.
   4. Use single-vane turning vanes in low pressure square elbows.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:
   1. Operate dampers to verify full range of movement.
   2. Inspect locations of access doors and verify that purpose of access door can be performed.
   3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
   4. Inspect turning vanes for proper and secure installation.
   5. Operate remote damper operators to verify full range of movement of operator and damper.

3.3 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION 15820
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Motors.”
3. Division 15 Section “Common Work Results for HVAC” for common mechanical drive requirements for fans and air moving equipment.

1.2 PERFORMANCE REQUIREMENTS

A. Classify according to AMCA 99.
1.3 SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

2. Design Calculations: Calculate requirements for selecting vibration isolators and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Roof framing and support members relative to duct penetrations.
2. Ceiling suspension assembly members.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Field quality-control test reports.
E. Operation and Maintenance Data: For power ventilators to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by an NRTL acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.6 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate delivery and placement of roof curbs, and equipment supports. Installation of roof curbs, equipment supports, and roof penetrations is specified in Division 07 Section "Roof Accessories."
1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

   1. Belts: One set for each belt-drive unit.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Acme Engineering & Mfg. Corp.; Models PRN and PV.
   2. Aerovent; a Twin City Fan Company.
   3. Greenheck; Models G and GB.
   4. Loren Cook Company; Models ACED and ACEB.
   5. Moffitt Corporation, Inc.
   6. PennBarry; a unit of Tomkins PLC; Domex.

B. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

C. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.

D. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

   1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
   4. Fan and motor isolated from exhaust airstream.
   5. Refer to Division 15 Section “Common Work Results for HVAC” for additional requirements.
F. Accessories:

1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
2. Disconnect Switch: Nonfusible type, with thermal-overload protection mounted inside fan housing, factory wired through an internal aluminum conduit.
3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.

G. Provide prefabricated roof curbs for each fan.

H. Capacities and Characteristics: Refer to schedule(s) on Drawings.

2.2 ROOF CURBS AND ACCESSORIES

A. Construction: Galvanized steel; mitered and welded corners; 1-1/2-inch thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch chemically treated wood nailer. Size as required to suit roof opening and fan base.

1. Manufacturers: Roof curbs shall be provided by the fan manufacturer, or one of the following:
   a. Creative Metals.
   b. Pate.
   c. Roof Products & Systems.
   d. ThyCurb.
   e. Any of the approved roof mounted exhaust fan manufacturers.

2. Configuration: Self-flashing without a cant strip, with mounting flange, and suitable for flat roofs with tapered insulation.
3. Height: Curb shall extend a minimum 12 inches above top surface of roof insulation.
5. Burglar Bars: Minimum 1/2-inch thick steel bars welded in place to form 6-inch squares.
6. Mounting Pedestal: Galvanized steel with removable access panel.

2.3 MOTORS

A. Comply with requirements in Division 15 Section "Motors."
2.4 SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Install floor-mounting units as specified in Division 15 Section "Mechanical Vibration Controls."

C. Secure roof-mounting fans to roof curbs with cadmium-plated hardware. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Division 15 Section "Mechanical Identification."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 15 Section "Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 16 Section "Grounding and Bonding."
D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.
2. Verify that unit is secure on mountings and supporting devices and that connects to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
3. Verify that cleaning and adjusting are complete.
4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.
C. Refer to Division 15 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.

D. Replace fan and motor sheaves as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION 15838
SECTION 15840 - AIR TERMINAL UNITS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

   1. Division 15 Section “Mechanical General Requirements.”
   2. Division 15 Section “Metal Ducts.”
   3. Division 15 Section “Temperature Controls.”

1.2 SUBMITTALS

A. Product Data: For each type of product indicated, include rated capacities, furnished specialties, sound-power ratings, and accessories.

   1. Liners and adhesives.
   2. Sealants and gaskets.
B. Shop Drawings: Detail equipment assemblies and indicate dimensions, required clearances, method of field assembly, components, and location and size of each field connection.

1. Include a schedule showing unique model designation, room location, model number, size, and accessories furnished.
2. Wiring Diagrams: Power, signal, and control wiring.

C. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Operation and Maintenance Data: For air terminal units to include in operation and maintenance manuals. Include the following:

1. Instructions for resetting minimum and maximum air volumes.
2. Instructions for adjusting software set points.

1.3 QUALITY ASSURANCE

A. Product Options: Drawings indicate size, profiles, and dimensional requirements of air terminal units and are based on the specific system indicated. Refer to Division 01 Section "Product Requirements."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by NRTL acceptable to authorities having jurisdiction, and marked for intended use.

C. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."
D. NFPA Compliance: Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

1.4 COORDINATION

A. Coordinate layout and installation of air terminal units and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 SINGLE-DUCT AIR TERMINAL UNITS

A. Manufacturers:

1. Anemostat; a Mestek Company.
2. Krueger; Tomkins PLC.
3. Nailor Industries of Texas Inc.
5. Titus; Tomkins PLC.
6. Tuttle & Bailey; Tomkins PLC.

B. Configuration: Variable and constant volume, medium pressure terminal units with casing, 24 volt control transformer, electrical service disconnect switch, 100 percent tight shutoff volume regulator with DDC operator, velocity sensor, and sound attenuating thermal insulation.

C. Casing: Constructed of 0.034-inch mill galvanized steel or 0.032-inch aluminum.

2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
3. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
5. Access: Removable panels for access to dampers and other parts requiring service, adjustment, or maintenance; with airtight gasket.

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 3-inch wg inlet static pressure.


F. Attenuator Section: 0.034-inch mill galvanized steel or 0.032-inch aluminum sheet metal.
   1. Lining: 1-inch-thick, coated, fibrous-glass duct liner complying with ASTM C 1071; secured with adhesive. Cover liner with nonporous foil.
   2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

G. Hot-Water Heating Coil: Copper tube, mechanically expanded into aluminum-plate fins; leak tested underwater to 200 psig; and factory installed.

H. DDC Controls: Single-package unitary controller and actuator specified in Division 15 Section "Temperature Controls."

I. Control Sequence: Refer to Temperature Control Diagrams on Drawings.

2.3 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Steel Cables: Galvanized steel complying with ASTM A 603.
C. 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.

D. Air Terminal Unit Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

E. Trapeze and Riser Supports: Steel shapes and plates for units with steel casings; aluminum for units with aluminum casings.

2.4 SOURCE QUALITY CONTROL

A. Identification: Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

B. Verification of Performance: Rate air terminal units according to AHRI 880.


PART 3 - EXECUTION

3.1 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 sufficient clearance for normal service and maintenance.

3.2 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Hangers Exposed to View: Threaded rod and angle or channel supports.
C. 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 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to air terminal units to allow service and maintenance.

C. Hot Water Piping: Unless otherwise indicated:
   1. Install union and isolation valve on supply-water connection.
   2. Install union and calibrated balancing valve or PICCV as indicated on the Drawings on return-water connection.
   3. Hydronic specialties are specified in Division 15 Section "Hydronic Piping."

D. Connect ducts to air terminal units according to Division 15 Section "Metal Ducts."

E. Ground units with electric heating coils according to Division 16 Section "Grounding and Bonding."

F. Connect wiring according to Division 16 Section "Conductors and Cables."

G. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 STARTUP SERVICE

A. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
2. Verify that controls and control enclosure are accessible.
3. Verify that control connections are complete.
4. Verify that nameplate and identification tag are visible.
5. Verify that controls respond to inputs as specified.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.
SECTION 15855 - DIFFUSERS, REGISTERS, AND GRILLES

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Related Sections include the following:

  1. Division 10 Section "Louvers and Vents" for fixed and adjustable louvers and wall vents, whether or not they are connected to ducts.
  2. Division 15 Section “Mechanical General Requirements.”
  3. Division 15 Section "Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.2 SUBMITTALS

A. Product Data: For each product indicated, include the following:

  1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
  2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.
B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

PART 2 - PRODUCTS

2.1 AIR DIFFUSION DEVICES

A. Manufacturers: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. Krueger-HVAC; Air Distribution Technologies, Inc.; a JCI Company.
2. Nailor Industries, Inc.
4. Titus; Air Distribution Technologies, Inc.; a JCI Company.
5. Tuttle & Bailey; Air Distribution Technologies, Inc.; a JCI Company.

B. Terminal air diffusion devices have been chosen in terms of specific air distribution requirements, spacing, and sound characteristics.

C. Provide plaster frames for units installed in plaster ceilings.

D. Provide gaskets for supply terminal air devices mounted in finished surfaces.

E. Finish:

1. Device Face and Visible Trim: Standard off white baked enamel finish unless noted otherwise.
F. Air pattern adjustments shall be made from the face of the device.

G. Refer to drawings and schedules for quantities, types, and finishes.

H. Coordinate frame types with Architectural Reflected Ceiling Plan.

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."


PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practicable. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
C. Wall-Mounted Supply Registers: Install 6 inches below finished ceiling unless otherwise indicated.

D. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 15855
SECTION 15900 - TEMPERATURE CONTROLS

PART 1 - GENERAL

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PART 3 - EXECUTION

3.1 INSTALLATION - CONTROL SYSTEMS
3.2 IDENTIFICATION AND MARKING
3.3 GRAPHIC DISPLAY GENERATION
3.4 OWNER INSTRUCTION AND TRAINING
3.5 CALIBRATION AND START-UP
3.6 ACCEPTANCE PROCEDURE
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”

1.2 SUMMARY

A. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

1.3 DEFINITIONS

A. BACnet: Communications open protocol for building automation system networks and control (developed by ASHRAE and documented per ANSI/ASHRAE Standard 135-2012.

B. BAS: Building Automation System

C. CAD: Computer Aided Design.

D. DDC: Direct-digital controls.

E. LonWorks (aka LonTalk): Communications open protocol as developed by Echelon Corporation that is utilized with building automation system networks and control.

1.4 SYSTEM DESCRIPTION

A. Temperature control building automation system consisting of direct digital control system controllers, sensors, transducers, relays, switches, data communication network, etc. and all associated control wiring and raceway systems.

B. BAS/DDC system programming, database generation. Graphic display generation accessible through Building Network Supervisory Controller.
C. Electric control valves, dampers, operators, control wiring, etc.

D. Electric and electronic control accessories, and other control system devices.

1.5 SEQUENCE OF OPERATION

A. Control sequences for HVAC systems, subsystems, and equipment are indicated on project drawings.

1.6 SUBMITTALS

A. Submit under Division 15 provisions of respective project and as supplemented in this section.

B. All control submittal requirements shall be submitted at one time with exception to control valves, automated dampers, and initial phases of work associated with fast-track projects (when required). Early submittals of control valve and automated dampers shall be incorporated with the complete temperature controls submittal.

C. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.

1. Each control device labeled with setting or adjustable range of control

D. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

E. Shop Drawings:

1. Shop drawings shall be done on CAD. Minimum size 11” x 17”.
2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
4. Details of control enclosure including panel faces and interior, including controls, instruments, terminations blocks and component labeling.

5. Written sequence of operation for each controlled system.

6. Schedule of dampers including size, leakage, and flow characteristics (Refer to Design Data).

7. Schedule of valves including leakage and flow characteristics (Refer to Design Data).

8. Complete bill of materials to identify and quantify all control components.

9. Overall system schematic showing communication trunk cabling from Building Network Supervisory Controller(s) to BAS field level controllers including component locations and wire termination details.

10. DDC controller layouts showing connected data points and LAN connections. DDC controller terminations including power supply and remote control component termination details shall be provided.

11. Point list for each DDC controller including point descriptions and addresses. This information may be incorporated with DDC controller layouts.

F. Design Data: Provide indicated component selection and sizing criteria for the following component categories:

1. Control valves:
   a. Component tag.
   b. Equipment served/function.
   c. Media type.
   d. Design flow rate (GPM).
   e. Design pressure drop (ft. head) or (psi), where applicable.
   f. Calculated valve Cv, where applicable.
   g. Selected valve Cv, where applicable.
   h. Resultant pressure drop (ft. head) or (psi) with selected valve.
   i. Valve size.
   j. Line size to valve connection (excluding reducers).
   k. Type (ball, butterfly, globe, etc.).
   l. Configuration (2-way, 3-way mixing, 3-way diverting).
   m. Normal position (normally open, normally closed, floating).
   n. Actuator spring range (where applicable).
2. Dampers:
   a. Component tag.
   b. Equipment served/function.
   c. Overall damper size (inch width x inch height).
   d. Quantity of damper sections with respective size(s):
   e. Material and gauge of thickness.
   f. Mounting orientation (horizontal or vertical).
   g. Blade configuration (parallel or opposed)
   h. Pressure drop (in. WG).
   i. Shut-off rating/differential pressure rating (in. wg).
   j. Leakage rating (CFM/sq.ft. at 4 in. wg).
   k. Normal position (normally open, normally closed, floating).
   l. Actuator spring range (where applicable).
   m. Actuator power requirement.
   n. Actuator torque requirement.
   o. Actuator quantity.
   p. Damper manufacturer/model number.
   q. Actuator manufacturer/model number.

G. Wall mounted temperature sensor, thermostat and/or other temperature control device cover color shall be coordinated to match color of wall mounted electrical device components and cover plates – coordinate with electrical contractor. Provide samples of available temperature control device cover colors to Architect upon request or if available temperature control device colors do not match electrical device colors so a desired color selection may be determined. Provide sample of temperature sensor / thermostat guard upon request of Architect, Engineer or Owner.

H. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

I. Submit field reports indicating operating conditions after detailed check out of systems at Date of Substantial Completion.
J. Project Record Documents: Include the following:

1. Revise Shop Drawings to reflect actual installation and operating sequences.
2. Record actual locations of control components, including control units, thermostats, and sensors.
3. Submit the electronic files for all as-built shop drawings on diskette in pdf format.

K. Software and Firmware Operational Documentation: Include the following:

1. DDC controller keypad operating instructions and DDC controller override features, where applicable.
2. Device address list.
3. Program Software Backup: On a magnetic media or compact disc, complete with data files.

L. Maintenance Manuals: Include the following:

1. Product data with installation details, maintenance instructions and lists of spare parts for each type of control device.
2. Keypad illustrations and step-by-step procedures indexed for each operator function, where applicable.
3. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
4. Calibration records and list of set points.

1.7 REFERENCES

A. AMCA 500 - Test Methods for Louvers, Dampers and Shutters.
B. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure fittings.
C. ANSI/ASTM B32 - Solder Metal.
F. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.
G. ASTM B75 - Seamless Copper Tube for General Engineering Purposes.

H. ASTM D1693 - Environmental Stress - Cracking of Ethylene Plastics.

I. NEMA DC 3 - Low-Voltage Room Thermostats.

J. UL 1820 - Fire Test of Pneumatic Tubing for Flame and Smoke Characteristics Only.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is a certified installer of the automatic control system manufacturer for both installation and maintenance of units required for this Project.

B. Manufacturer Qualifications: A firm experienced in manufacturing automatic temperature-control systems similar to those indicated for this Project and with a record of successful in-service performance.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

1.9 DELIVERY, STORAGE, AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated or optional to be factory mounted on equipment, arrange for shipping of control devices to unit manufacturer.

1.10 COORDINATION

A. Coordinate work under Division 15 provisions and as supplemented in this section.

B. Coordinate location of space temperature sensors and other exposed control sensors with plans and room details before installation.
C. Coordinate installation of system components with installation of mechanical systems and equipment to achieve compatibility.

D. Ensure installation of components is complementary to installation of similar components in other systems.

E. Coordinate control wiring requirements, including actual terminal block numbers, with mechanical equipment manufacturers or suppliers.

F. Ensure control system installation is complete, checked, tested and functioning properly prior to system balancing and Owner/Engineer system checkout.

G. Cooperate fully with the Test and Balance Contractor and provide labor to operate the temperature control system as required to meet the scope of work defined in Division 15 Section "Testing, Adjusting and Balancing."

1.11 WARRANTY

A. Provide warranty per Division 15 Section "General Mechanical Requirements" and as supplemented in this section.

B. Provide 24 hour per day emergency service during warranty period, with maximum response period of four (4) hours. Provide phone number(s) for quick assistance by a Service Engineer regarding hardware or software problems.

C. Provide scheduled maintenance service during warranty period to inspect, calibrate, and adjust controls. Make a minimum of one eight hour service call every three months. Notify Owner prior to each scheduled inspection trip. Submit written reports upon completion of service.

D. Provide any software or firmware revisions which are released by the DDC system manufacturer during the warranty period, at no additional cost to the Owner.

1.12 POSTED OPERATING INSTRUCTIONS

A. Provide DDC controller related as-built documents in protective binder or clear plastic display envelope for each control enclosure panel. These instructions shall include such items as as-built control diagrams and
sequence of operation, simplified narrative instructions and materials necessary to aid in the operation of the equipment at the local control panels.

1.13 SPECIAL TOOLS

A. Deliver two sets of any special tools required for operation, adjustment, resetting or maintenance, not including PC laptop.

1.14 PROTECTION OF PROPRIETARY INFORMATION

A. All proprietary manuals and software that are subject to a non-disclosure agreement shall be submitted by the proprietary equipment manufacturer to the Owner for signed approval during the warranty period.

PART 2 - PRODUCTS

2.1 DESCRIPTION OF THE BUILDING AUTOMATION SYSTEM (BAS)

A. The building automation system (BAS) shall be fully integrated, distributed data processing system incorporating direct digital control (DDC) for the control and monitoring of heating, ventilating and air conditioning (HVAC) equipment and other related systems. Microprocessor based BAS field level DDC controllers shall be directly connected to HVAC equipment sensors and actuators. A data communication network shall allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller. The Building Network Supervisory Controller shall be the primary operator BAS interface point for the building either through web-browser direct or through server application software (if existing).

B. Approved Manufacturer - System / Installer (Location):

1. Honeywell - Comfort Point / Honeywell, Inc. (Wixom, MI).
2. Honeywell - WEBS / Control-Net (Detroit, MI).
6. Johnson Controls – Facility Explorer / K&S Ventures, Inc. (Rochester Hills, MI)
8. Johnson Controls – Facility Explorer / Metro Controls, Inc. (Clinton Twp, MI)

2.2 BAS BUILDING NETWORK SUPERVISORY CONTROLLER

A. The Building Network Supervisory Controller shall provide the interface between the Owner’s Ethernet and the field control devices, and provide global supervisory control functions over the control devices connected to the Building Network Supervisory Controller. It shall be capable of executing application control programs to provide:

1. Calendar functions
2. Scheduling.
3. Trending.
5. Time synchronization.
6. Integration of BACnet controller data.
7. Network Management functions for all BACnet based devices.

B. The Building Network Supervisory Controller shall provide the following hardware and driver features as a minimum:

1. One RS-232 port
2. One RS-485 port with BACnet MS/TP Driver.
3. Battery Backup
4. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity).
5. Where the option for expanded memory is available, it must be supplied.
C. Provide LonWorks or MODBUS driver(s) as required for system or equipment integration requirements for project.

D. Manufacturer:

1. Honeywell, Johnson Controls or Vykon Niagara 4 JACE-8000 series, sized appropriately per building to handle the required quantity of connected controllers and devices. Provide 5 year service agreement per supervisory controller for updating firmware/software as available by manufacturer. Labor for updating the controllers shall be included. If AX version of server application software existing, adjust the N4 version to communicate with the AX platform.

2.3 DIRECT DIGITAL CONTROL (DDC) FIELD LEVEL CONTROLLERS

A. Modular in design and consisting of stand-alone microprocessor board with ROM and fully custom programmable RAM, EPROM, and/or EEPROM memory, integral interface equipment and power surge protection. DDC controllers shall be connected directly to sensors, controlled devices and the communication network.

B. Powerfail Restart and Battery Backup: Minimum of 72 battery backup hours for complete system RAM memory and clock, with automatic battery charger or 48 hour low voltage alarm warning. Upon full system power recovery, all clocks shall be automatically synchronized, and all controlled equipment shall be automatically re-started based on correct clock time and sequence of operation.

C. Provide fully functional communication interface ports for communication between processor, other processors, portable programmer’s terminal, portable operator’s unit or the remote Operator Workstation when applicable for project.

D. Panel enclosure for controller, associated power supply and other ancillary control components shall be finished steel or rigid plastic with hinged door and keyed lock. Electronics shall be removable for protection during mounting of panel.
2.4 DDC CONTROLLER SOFTWARE

A. Operating system shall work in real time, provide prioritized task scheduling, control time programs, monitor DDC controller communications, scan inputs and outputs, and contain built-in diagnostics.

B. Input/output point processing shall include the following:

1. Continuous update of input and output values and/or conditions. All connected points are to be updated at least once per second.
2. Assignment of proper engineering units and status condition identifiers to all points.
3. In addition to physical or "hardware" points required, "software" points shall be provided where required for command access and meaningful displays, where required by the "execution" portion of this section or where required on the DDC input/output points lists. "Software" points shall appear identical to physical points in output displays and shall be assignable to text descriptors, logical groups, reports, etc. in the same manner as physical points. "Software" points shall be assigned alarm limits in the same manner as physical points.

C. Command control software shall manage the receipt of commands from control panels, portable programmer’s terminal, portable operator’s unit or the remote Operator Workstation when applicable for project.

1. Command delay, programmable from 0 to 2 minutes, shall be provided to prevent simultaneous energizing of large loads. Command delays shall be honored throughout the BAS DDC network, not just within the DDC controller. Delays shall be assignable on an individual per point basis.
2. Each command shall be assigned a command and residual priority to manage contentions created by multiple programs having access to the same command point. Only commands with a higher command priority than the existing residual priority shall be permitted to execute. Whenever a command is allowed to execute, its assigned residual priority shall replace the existing residual priority.
3. A "fixed mode" option shall be supported to allow inputs to, and outputs from DDC control programs to be set to a fixed state or value. When in the "fixed mode," inputs and outputs shall be so noted in all reports.

4. A "last user" record is to be maintained to positively identify which program or manual command is in control of a given point. The last user information shall be displayed and printed along with other point data of logical groups.

D. Provide self-test procedure. Provide remote notification for maintenance, performance, software, cable break, or data transmission problems. Identify variables as reliable or unreliable. Variables identified as unreliable shall use default in calculation.

E. Alarm Processing

1. High/Low Alarm: Analog input alarm comparison with the ability to assign two individual sets of high and low limits (warning and actual alarm) to an input. Each alarm shall be assigned a unique differential to prevent a point from oscillating into and out of alarm. Alarm comparisons are to be made each scan cycle.

2. Floating Alarm: Where analog controlled values are automatically varied by software (such as hot water temperature reset), a single set of alarm limits shall be provided for those varying values. These alarm limits shall then "float" a user definable differential above and below the varying setpoint value.

3. Abnormal Alarm: When a digital input is not in agreement with the commanded state of its associated output point, or when a digital input is not in its normal state, an abnormal alarm shall be generated. Abnormal "on" shall cause an alarm, as well as abnormal "off." Alarm time delay for digital inputs to prevent nuisance alarms shall be provided. Each digital input alarm time delay shall be adjustable from zero to two minutes in one-second increments.

4. Alarm lockout shall be provided to positively lock out alarms when equipment is turned off or when a true alarm is dependent on the condition of an associated point. Lockout points and lockout initiators shall be
operator programmable. On initial startup of air handler and other mechanical equipment, a "timed lockout" period shall be assigned to analog points to allow them to reach a stable condition before activating alarm comparison logic. Timed lockout period shall be programmable on a per point basis from 0 to 90 minutes in one-minute increments.

5. The capability of automatically initiating commands upon the occurrence of an alarm.

F. Totalization

1. Run time shall be accumulated based on the status of digital input points. It shall be possible to totalize either on time or off time up to 10,000 hours with one-minute resolution. Run time counts shall be resident in memory and have DDC controller resident run time limits assignable through portable programmer’s terminal, portable operator’s unit or the remote Operator Workstation when applicable for project.

2. A transition counter shall be provided to accumulate the number of times a device has been cycled on or off. Counter shall be capable of accumulating 600,000 switching cycles. Limits shall be assignable to counts to provide maintenance alarm printouts.

3. Analog totalization capability shall be provided to allow the totalization of electricity, air, water and steam flow, etc. These flows shall be totalized with respect to time and converted to the appropriate energy unit. It shall be possible to automatically set time intervals for totalization, adjustable from one second to 365 days. The totalization program shall keep track of the maximum and minimum instantaneous analog value measured during the period, including the date and time at which each occurred.

G. DDC Controller Programming / Configuration

1. All DDC controllers shall be fully programmable or configurable per required controller application type. DDC controllers which require remote or factory programming or configuration are not acceptable. DDC controllers with custom programs which may not be modified by the user are not acceptable. "Custom" programming shall mean allowing the alteration of
actual control logic, and shall not be limited to allowing only the alteration of setpoints, gains, parameters, time constants, etc.

2. DDC controllers shall be provided to meet the control strategies as called for in the sequences of operation on the drawings. If a configurable application specific DDC controller cannot meet this requirement, a DDC fully programmable controller shall be provided.

3. All DDC controller setpoints, gains, parameters, time constants, etc., associated with DDC controller programs shall be available to the operator for display and modification via portable programmer’s terminal, portable operator’s unit or the remote Operator Workstation when applicable for project.

4. Each DDC controller shall have resident in its memory and available to the programs a full library of DDC algorithms, intrinsic control operators, and arithmetic, logic and relational operators for implementation of control sequences. Functions to be provided shall include, but not be limited to, the following:

   a. Mathematical: Absolute value, calculate, square root, power, sign, average, totalize.
   b. Logic: OR, AND, compare, negate.
   c. Fixed Formula: High and low select, span, rate, ramp, enthalpy, wet bulb, dew point, relative humidity, humidity ratio, and filter.
   d. Data Manipulation: Store, file and set.
   e. Control Routines: Real-time based functions, proportional control, proportional-integral control, proportional-integral-derivative control, adaptive control (self-tuning), direct-acting, reverse acting, feedforward, fixed setpoint, calculated setpoint, adjustable setpoint, lead lag, hysteresis correction, event initiation/software interlock.

H. Building Automation System program applications (as required for controllers)

1. Time of day scheduling: Allow the creation and maintenance of operating schedules for selected points based on time of day and holiday scheduling. At least two independent start and stop times per day for each system shall be allowed. Each point shall be allowed
to have a unique time program, or points shall be able to be grouped and assigned to a common time program. Both digital and analog output points shall be able to be assigned to a time program. This software shall work in conjunction with the time of day scheduler software at the remote Operator Workstation (when applicable for project). This program shall also work in conjunction with the optimum start and optimum stop application software.

2. Optimum Start: Start equipment based on outdoor temperature, space temperature, and system response to minimize energy usage and to assure that comfort conditions are reached exactly at scheduled occupancy time (occupancy schedules are defined under "Time Of Day Scheduling"). This program shall operate in both the heating and cooling cycles. An adaptive algorithm shall be employed which automatically adjusts the start time according to previous performance and shall automatically assign longer lead times for weekend and holiday shutdowns.

3. Enthalpy Optimization: Using standard psychrometric calculations, automatically determine which air source, outdoor air or return air, presents the least total heat load, and automatically adjust mixed air damper position. When outside enthalpy exceeds return air enthalpy, the outside air damper shall go to its minimum position. Typically, the outside air damper must be in its minimum position before the cooling coil valve is allowed to open.

4. Duty Cycle: Periodically cycle electrical equipment to reduce energy consumption and/or energy demand. Each load shall be assigned a cycle interval and an off period. A load leveling algorithm shall be utilized to assure that cycle periods do not coincide.

5. Demand Limiting: Distributed power demand program shall be based on a sliding window instantaneous demand algorithm. The DDC controller(s) connected to the demand meter shall calculate the demand, forecast the demand trend, compare it to established demand limits, and initiate load shedding action or reestablishment of loads as required. Shedding shall be on a sequential basis with least important loads shed first and restored last. Restoration cycle shall add the most important loads first. DDC controllers on the network shall each have a four-tier shed table for assignment of sheddable loads. When a request is
issued to the network to shed a specific number of kilowatts, each DDC controller shall shed Tier 1 loads, Tier 2 loads, etc. until the shed requirement is met. The program shall have the capability to sum the readings from multiple meters connected to multiple DDC controllers on the network, and to shed various loads from multiple DDC controllers on the network.

6. Warm-Up: Position the outside air dampers in an adjustable (minimum) position, and trigger a digital output(s) normally used to signal air terminal units to move to their maximum flow settings. When the desired space temperature is reached, as determined by feedback from space temperature sensor(s), the digital output shall return the air terminal units to their normal operation. When occupancy time is reached, the outside air dampers shall be controlled by the normal occupied mode control sequence. During the warm-up cycle, the outside air damper shall be set at the position which minimizes outside air intake while preventing over/under pressurizing of ductwork. This program shall work in conjunction with the time scheduling program and/or the optimum start program as required.

7. Night Cycle: Cycle HVAC equipment on and off as required to maintain an operator selectable unoccupied space temperature. During the equipment "on" time, the outside air damper shall be maintained in an adjustable position which minimizes outside air intake while preventing over/under pressurization of ductwork. The equipment shall be cycled such that energy reduction during unoccupied periods is uniform.

8. Night Purge: Night Purge program shall apply to cooling cycle only. Night Purge shall introduce 100% outdoor air any time the outdoor air is above 50 degrees F, the space temperature is above 75 degrees F, the outdoor air temperature is below space temperature and the outdoor air dew point is less than 60 deg F. Purging shall stop when outdoor air is below 50 deg F, or space temperature is below 75 deg F, or outdoor temperature is less than 5 deg F cooler than space temperature, or outdoor air dew point is greater than 60 deg F.

9. Reset Optimization: Adjust equipment discharge setpoints based on one of the following criteria:
a. By sensing the worst case requirements (e.g., the zone requiring the most heating or cooling and providing only the minimum energy required to meet the load.

b. Adjusting the setpoint in direct proportion to another sensed variable (e.g., reset supply water temperature based on outside temperature).

2.5 DDC AIR TERMINAL UNIT CONTROLLERS

A. Microprocessor based controllers capable of stand-alone operation for control of pressure independent air terminal units. Controllers shall be networked together and connected to the building's BAS/DDC network.

B. Controllers shall have separate adjustable minimum and maximum airflow setpoints. Controllers shall work in conjunction with the air handling unit's DDC panel to provide the sequence of operation as indicated on the drawings. Setpoints shall be adjustable through the portable programmer terminal.

C. Provide electronic type air terminal unit damper operators compatible with the controller and the air terminal units provided.

D. Each controller shall have an internal differential pressure transducer capable of utilizing the total and static pressure signals from the air terminal unit's velocity sensor. Velocity sensor shall be furnished by air terminal unit manufacturer.

E. Each controller shall have electronic outputs compatible with the electronically operated air terminal unit tempering coil control valve and perimeter radiation control valve where applicable.

F. TC contractor shall provide 24 VAC power requirements including transformers.

G. If coordinated with mechanical contractor. Controllers and damper operators shall be furnished to the air terminal unit manufacturer for factory mounting by the air terminal unit manufacturer; otherwise, controls shall be field installed.
H. Room temperature sensors for the DDC air terminal unit controllers:

1. Sensing Element: Thermistor or resistance temperature detector (RTD) type. Accuracy shall be +/- 0.5 degrees F over the range of 55 degrees F to 95 degrees F, including calibration error, repeatability, hysteresis, and yearly drift.
2. Cover: Locking type.
3. Provide with exposed setpoint adjustment dial and exposed temperature reading.
4. Provide with exposed override switch to allow an occupant to reset the space to occupied control during the unoccupied cycle for a predetermined time period.
5. Provide with portable operator unit plug-in port.

2.6 DDC INPUT/OUTPUT SENSORS

A. Current Switches:

1. Split-core or donut type transformer for monitoring AC current, with digital output signal. Current switches used on motor side of variable frequency drives shall have low frequency detection capability.
2. Current switches with digital output shall have adjustable trip settings. Provide field adjustment of current switches to trip at approximately 90% of normal motor operating amperage.
3. Manufacturers:
   a. Johnson Controls.
   b. NK Technologies.
   c. Senva.
   d. Setra.
   e. Veris Industries.

B. Differential Pressure Transmitters (Commercial Version):

1. Transmitters used for measuring differential pressure only:
   a. Each differential pressure transmitter shall be selected and calibrated for operations between 0 and 200% of the normal differential pressure. The calibration point shall be rounded upward to the nearest 10 inches of water column (for spans less than 200" W.C.) or to the nearest 5 psi for larger
spans. Calibration date shall be included on an embossed tag attached to each transmitter.

b. The accuracy, including linearity, hysteresis and repeatability, of the transmitter for measuring differential pressure shall be better than 2% of the span stated above throughout a 4:1 turndown.

c. The transmitter shall not be damaged by pressures of up to 500 psig on either side of the transmitter and all wetted parts shall be essentially inert in the presence of up to a 40% concentration of ethylene or propylene glycol in water.

d. Provide a drain valve for each side of the pressure chamber. Furnish and install mounting brackets appropriate for the installation location.

e. Span and zero shall be individually adjustable.

f. With LCD Display.

g. Manufacturers:

1) Dwyer.
2) Setra.
3) Veris Industries.

C. Outside Air Temperature/Humidity Combination Transmitters:

1. Dual transmitters housed in a single hinged enclosure with integral probes configured for exterior wall mount application with PVC sun shield. Unit shall provide separate 4-20 mA signals for temperature and humidity measurement.

2. Temperature sensor shall be 1000 OHM thin film platinum resistance temperature detector with matching 4-20 mA transmitter having independent zero and span adjustments. Accuracy shall be ± 0.5 degrees F with a range of -25 degrees F to 125 degrees F.

3. Humidity sensor shall be washable thin film type with matching 4-20 mA transmitter having independent zero and span adjustments and linear output over a span of 0-100% RH. Accuracy shall be ± 2.5% RH including calibration error, repeatability and hysteresis throughout the range of 0-95% RH at 77 deg F.

4. Manufacturer:

a. GE Industrial, Sensing (formerly General Eastern)
b. Veris.
D. Temperature Sensors:

1. Resistance temperature detectors (RTD) with platinum, nickel or bimetal element. Accuracy shall be +/- 0.5 deg F over the entire range. Range shall be as indicated below, or as appropriate to the application.

2. Single point duct mounted sensors shall have 18" rigid probe and calibrated span of 20 - 120°F.

3. Averaging duct mounted sensors shall have 25' long averaging element and calibrated span of 20 - 120°F.

4. Liquid immersion sensors shall have welded stainless steel thermowells for ferrous pipe and brass thermowells for copper pipe. Length of sensor and thermowell shall be selected based on the diameter of the pipe to provide accurate, reliable and homogeneous sensing of the liquid temperature. Thermowell pressure rating shall meet or exceed the system minimum pressure rating. Sensors for chilled water application shall have calibrated span of 20 - 120°F. Sensors for hot water applications shall have calibrated span of 40 - 240°F.

5. Room sensors shall have locking cover and a minimum span of 40 - 90°F.

6. Outside air sensors shall have watertight inlet fitting and shall be shielded from direct rays of sun and wind.

7. Manufacturers:

   a. Specified BAS product where available.
   b. TCS.
   c. Minco.
   d. ACI.
   e. MAMAC.

2.7 DDC DATA COMMUNICATIONS NETWORK

A. Data communication network shall be provided to allow data exchange between the BAS field level DDC controllers and the Building Network Supervisory Controller.

B. The BAS/DDC system-wide communication network shall consist of a primary peer-to-peer network, and at the Contractor's option, secondary sub-networks linked to the primary network. The primary network shall support peer-to-peer communications between primary network BAS field level DDC controllers. The Building Network Supervisory
Controller shall be connected to the primary network. Secondary sub-networks when used shall interface with the primary network through the primary network BAS field level DDC controllers. At least one DDC controller connected to the primary peer-to-peer network shall be provided in each mechanical room, or as indicated on the drawings.

C. Data communications media shall be twisted pair wires.

D. The communications network shall allow shared point and control information between BAS field level DDC controllers. All required repeaters, hubs, active links, gateways, etc. and associated power supplies shall be provided as required to provide shared point and control information between BAS field level DDC controllers.

E. Failure of any individual BAS field level DDC controller shall not cause the loss of communications between peer BAS field level DDC controllers.

F. All data transmitted must be positively acknowledged as received or negatively acknowledged as not received. Negative acknowledgments shall cause a retransmission of the data. Network connected devices must send a "functioning" message each network cycle. Lack of a "functioning" message after successive retries shall constitute a device failure and shall be recognized as such by the network.

G. Error recovery and communication initialization routines shall be resident in each network connected device.

2.8 CONTROL AND INSTRUMENTATION TUBING

A. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.

B. Copper Tubing: ASTM B280 or ASTM B75, seamless, hard drawn or annealed.
   1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
   2. Joints: Ball Sleeve compression type.
C. Polyethylene Tubing: Black, UL 1820 flame and smoke retardant where exposed in an air plenum, virgin polyethylene, conforming to modified ASTM D1693 test. All non-metallic tubing shall be minimum 1/4" O.D.; micro-sleeve is not acceptable.

1. Fittings: UL approved rod or forged brass rated to 200 psig at 100 degrees F.
2. Joints: Compression or barbed type.

2.9 CONTROL VALVES AND VALVE OPERATORS

A. Pressure Independent Control Valves (2-way):

1. Up to 2 inches: Characterized ball valve or Globe valve style with integral pressure compensating cartridge which maintains a constant pressure drop across valve seat while providing equal percentage flow control. Ball valve construction shall include bronze or brass-nickel plated body with screwed ends, stainless steel or chrome plated brass ball, characterizing disc, stainless steel or brass stem, and resilient reinforced Teflon seats. Globe valve construction shall include bronze or AMETAL (a dezincification alloy of TA), stainless steel or brass stem and EPDM type seats.

2. Over 2 inches: Control valve with integral pressure compensating spring and diaphragm which maintains a constant pressure drop across the valve seat, iron body with flanged ends, stainless steel trim.

3. Accuracy: Control valves shall accurately control flow from 0 to 100% of the full rated flow. Flow through the valve shall not vary more than +/- 5% due to system pressure fluctuations when the pressure drop across the valve is within the range of 5 psid to 35 psid.

4. Manufacturers:
   a. Belimo.
   b. Bray / Delta Control Products.
   c. Honeywell.
   d. Johnson Controls.

B. Pressure dependent Characterized Ball Valves (3-way):

1. Up to 2 inches: Bronze body with screwed ends, stainless steel or chrome plated brass ball,
characterizing disc, stainless steel or brass stem, and resilient reinforced Teflon seats.

2. Manufacturers:
   a. Belimo.
   b. Bray / Delta Control Products.
   c. Honeywell.
   d. Johnson Controls.

C. Electric Operators:

1. Operators shall be electronic type to accept signals from direct digital controller or modulating thermostat for proportional control.
2. Valves shall spring return to normal position as indicated. Terminal unit tempering coil control valve operators are not required to be spring return.
3. Select with sufficient shut-off power for system pressure and highest operating torque, and torque requirements of valves which may stick because of infrequent use.
4. Select to provide smooth proportioning control under operating conditions normal to the system.

D. Hydronic Systems:

1. Valve minimum pressure rating shall meet or exceed the system minimum pressure rating as noted for each system in Division 15 Section “Valves,” and in Division 15 Section “Hydronic Piping.”
2. Valve minimum temperature ratings shall be 212 deg F.
3. Two way and three way valves shall have equal percentage characteristics. Size two way valve operators to close valves against pump shut off head.
4. Pressure independent control valves shall be used for 2-way applications unless otherwise indicated. Select to achieve scheduled flow rate of the associated heat transfer device. If the scheduled flow rate is too high to achieve with one valve, provide multiple valves sized at flow divided equally of the scheduled flow rate and control all valves in unison - coordinate control valve quantity and the need for parallel piping of control valves with mechanical contractor.
5. Pressure Drop for pressure dependent characterized ball and globe valves: As scheduled on the drawings.
If not scheduled, primary HVAC equipment control valves shall be selected for a pressure drop close as possible to 11.5 feet of head (5 psig), +/- 10%. If not scheduled, terminal equipment control valves shall be selected for a pressure drop close as possible to 11.5 feet of head (5psig) with allowable minimum of 2.3 feet of head (1 psig) where flow rates are minimal and valve Cv choices are limited. TC Contractor shall use valves from listed manufacturers that meet the pressure drop requirements.

2.10 DAMPERS - AUTOMATED

A. Performance: Test in accordance with AMCA 500.

B. Frames: Galvanized steel, minimum 16 gauge, minimum 2 inches in width, welded or riveted with corner reinforcement for 12 gage structural equivalence.

C. Blades: Galvanized steel, minimum 14 gauge, maximum blade size 8 inches wide, 60 inches long, attached to minimum 1/2 inch shafts. Dampers which are required to have a static pressure rating over 4 inch W.G. shall have minimum 3/4 inch solid shafts.

D. Blade Seals: Synthetic elastomeric or Neoprene, mechanically attached, field replaceable.

E. Jackshafts (where required): Minimum 1/2 inch galvanized steel.

F. Jamb Seals: Stainless steel.

G. Bearings: Oil impregnated sintered bronze or lubricant free, solid stainless steel. Provide thrust washers at bearings for all dampers which are to be mounted with blades in the vertical position.

H. Linkages: Accessible for maintenance. Linkages may be located in airstream. Linkages located in damper frame shall be external to the duct, accessible for maintenance. Linkages located in the airstream shall be zinc-plated.

I. Leakage: Less than 8 CFM per square foot based on 4 inches W.G. pressure differential.
J. Static Pressure Rating: As scheduled on the drawings, or if not scheduled, minimum 4" W.G.

K. Maximum Velocity: As scheduled on the drawings, or design for maximum velocity to be encountered in location where installed.

L. Temperature Limits: -40 to 200 deg F.

M. Manufacturers:
   1. American Warming & Ventilating.
   2. Arrow United Industries.
   4. Honeywell.
   5. Johnson Controls.
   6. Louvers & Dampers, Inc.
   7. Ruskin.
   8. Tamco.

2.11 DAMPER OPERATORS - ELECTRIC

A. Electric damper motor shall be 24 or 120 volt two-position or modulating as required with spring return type and sized to operate the damper with sufficient reserve power for smooth operation from full close to full open and tight shut-off. Damper motor shall have "O ring" gaskets for weatherproof operation.

B. Number: Sufficient to achieve unrestricted movement throughout damper range. Provide sufficient number of operators such that one operator does not operate more than the maximum square footage of damper area as recommended in standard catalog of manufacturer.

C. Manufacturers:
   1. Belimo.
   2. Delta Control Products.
   3. Honeywell.
   4. Johnson Controls.

2.12 ELECTRICAL REQUIREMENTS FOR CONTROLS WORK

A. Electrical accessories such as relays, switches, contactors and control transformers shall meet the
requirements of the Division 16 Specifications of respective project.

B. Electrical wiring and conduit shall meet the requirements of the Division 16 Specifications.

C. All control wiring in mechanical rooms and any other exposed areas shall be run in conduit. Low voltage temperature control wiring in concealed accessible locations (i.e. above lay-in ceilings), as well as low voltage temperature control wiring within partitions, may be run using plenum rated cable, neatly tie-wrapped and fastened to the building structure (not to ceiling or ceiling support wires).

D. Conduits carrying control wiring shall be sized for a maximum fill of 40% of capacity.

E. Where raceway is required, two separate raceway systems shall be provided; one for A.C. wiring and the other for D.C. wiring.

F. Data transmission cabling and equipment grounding procedures shall meet the latest FCC guidelines for electromagnetic field generation.

G. All control wiring sizes and types shall meet or exceed the equipment manufacturer's recommendations.

2.13 EMERGENCY POWER-OFF (EPO) PUSH-BUTTON

A. ADA compliant, push-button switch with clear cover to prevent inadvertent closure. Push-to-activate push-button, and providing two SPDT contacts rated 10 Amps at 120 VAC.

B. Manufacturers:
   1. Safety Technology International – model SS-2212PO

2.14 LOCAL AND AUXILIARY CONTROL COMPONENT ENCLOSURE PANELS

A. Unitized cabinet type for each system under automatic control with relays and controls mounted in cabinet and temperature indicators, pressure gauges, pilot lights, pushbuttons and switches flush on cabinet panel face, or as detailed on drawings. Provide panel with locking door.
B. ANSI/NEMA 250, general purpose utility enclosures with enameled finished face panel, or as indicated on the drawings.

C. Panels shall be sized for a maximum fill of 50% capacity, and shall not be smaller than 24" X 24".

2.15 REFERENCE PROBE - DUCT STATIC PRESSURE

A. Duct static pressure probe shall be capable of static pressure measurement with bi-directional flow in a duct, plenum or air handling unit. Probe shall have minimum 4" insertion depth, shall compensate for total pressure error, and shall provide an accurate, repeatable and stable static pressure value with a maximum flow of 4000 fpm.

B. Probe shall be constructed of aluminum, with mounting flange suitable for round or flat duct surfaces. Probe shall have static pressure signal fitting.

C. Manufacturers:
   1. MAMAC # A-520.
   2. Dwyer # A-305.
   3. Tek-Air # T-SPP 7100/7200.

PART 3 - EXECUTION

3.1 INSTALLATION - CONTROL SYSTEMS

A. Install in accordance with manufacturer's instructions.

B. Check and verify location of temperature sensors, thermostats and other exposed control sensors with plans and room details before installation. Locate room temperature sensors and thermostats 48 inches above floor unless noted otherwise.

C. The location of all control-related items to be mounted on the exterior of the building must be approved by the Architect prior to installation. Indicate proposed locations on the shop drawings.

D. Caulk both sides of damper frames to duct walls to prevent leakage between damper frame and duct.
E. Mount control panels adjacent to associated equipment on vibration free walls or free standing angle iron supports. Sensors used for closed loop control must be connected to the same DDC controller as the associated output signal.

F. Provide conduit and electrical wiring where required.

G. All wiring in altered and unaltered areas shall be run concealed. "Wiremold" in finished areas shall be allowed when wiring cannot be run concealed in walls or partitions. Minimize "wiremold" routing.

H. Splicing of DDC sensor cabling at junction boxes shall not be acceptable.

I. All equipment which has moving parts and is remotely started by the control system shall be provided with warning labels no less than 2 inches in height, and in bright warning color, stating that the equipment is remotely started by automatic controls. Such labels shall be posted clearly in the area of any moving parts, such as belts, fans, pumps, etc.

J. Locate all control components and accessories such that they are easily accessible for adjustment, service and replacement.

K. Locate, size and support sensing elements in airstreams so that they properly sense the representative condition. Controlling, transmitting and indicating elements shall be located to sense the average condition. Safety elements shall be located to sense the extreme condition.

L. Locate and size sensing elements in liquid lines so that they are in moving liquid and not in stagnant or turbulent locations. Wells shall not obstruct the flow of the liquid being measured. Pipes one inch and smaller shall be increased at least one pipe size at the point of insertion.

M. Locate pressure sensing taps in liquid lines in straight runs of pipe with at least 10 pipe diameters of straight pipe both upstream and downstream of pressure tap. Provide a shut-off cock in sensing line at each pressure tap.
N. Install pressure sensing elements in ducts and casings with clean, sharp taps to accurately read true static pressure, avoiding velocity influence and turbulence.

O. Locate, support and install all control components and accessories so that they will not be subject to vibration, excessive temperatures, dirt, moisture or other harmful conditions beyond their rated limitations.

P. Where insulation is penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight. Provide brackets for devices to be located on insulated surfaces so as to clear the finished surface of the insulation and to avoid puncturing the vapor seal.

Q. Provide all necessary relays, switches, linkages, control devices, accessories and connections as required for a complete and operational control system as specified herein and shown.

R. All electric valve and damper operators shall be capable of moving from full closed to full open, or vice versa, within 120 seconds.

3.2 IDENTIFICATION AND MARKING

A. All sensors, relays, switches, etc. shall be marked with the same identification number as used on the as-built shop drawings. Use Brother P-touch label maker or similar with black text on clear or white super adhesive tape. If label applied in wet environment, spray label with clear enamel for waterproofing.

B. Wire shall be color coded according to functional use. Identify color coding format on record drawings.

C. Identify each wire as to ID number at each controller termination, field device termination or on the field device.

D. All control panels and auxiliary enclosures shall be supplied with engraved phenolic nameplate permanently attached identifying it as control panel number, system served, area served, fed from lighting panel number, circuit number, etc.
E. Temperature control conduit and junction box covers shall be painted Blue to signify that it is used for temperature controls. All junction box covers shall be painted Blue and the conduit shall be painted with an Blue mark (approximately 6 inches long) every 36” to 48”, and on both sides of all penetrations.

3.3 GRAPHIC DISPLAY GENERATION

A. Provide the following graphic displays as a minimum at the operator interface, arranged in logical penetration paths:

1. If server application server existing for monitoring other buildings, edit overall campus layout to show new building on the Owner's campus.
2. Individual building layout or isometric for each building connected to the system.
3. Floor plans for each floor within each building, with display of present values of space conditions sensed by connected space sensors, display of the name of the air handler associated with each space sensor, display of the room number in which the sensor is located and color coding to indicate whether the sensed space condition is within the acceptable range, is too high, or is too low. TC Contractor shall confirm Owner desired room names prior to graphics generation which may differ from the room names indicated on construction documents.
4. Schematic diagram for each HVAC system. Each system schematic display shall include at least the following:
   a. Schematic arrangement of ductwork, fans, dampers, coils, valves, piping, pumps, equipment etc.
   b. System name.
   c. Area served.
   d. Present value or status of all inputs, along with present setpoint.
   e. Present percent open for each damper, valve, etc. based on commanded position.
   f. Reset schedule parameters for all points, where applicable.
   g. Present occupancy mode.
   h. Present economizer mode, where applicable.
   i. Present outside air temperature.
j. Associated space conditions and setpoints, where applicable.
k. Status of application programs (e.g., warm-up, night cycle, duty cycle, etc.).
l. Color coding to indicate normal and abnormal values, alarms, etc.

5. Manual override capability for each on/off or open/closed controlled digital output (for fans, pumps, 2-position dampers and valves, etc.) and each modulating analog output (for dampers, valves, VFD speed modulation type points, etc) shall be provided. Graphic display of output point auto or manual override status shall be provided.

6. Sequence of operation in written (text) format for each HVAC system.

7. Overall BAS system schematic.

8. System management graphic for each network device and/or DDC controller.

3.4 OWNER INSTRUCTION AND TRAINING

A. Provide a minimum of sixteen (16) hours of on-site instruction and training to the Owner on the operation of the control systems for the initial installation.

B. Instruction and training shall be performed by a competent Contractor representative familiar with the control systems operation, maintenance and calibration.

C. Training shall take place after check, test, start-up of temperature controls system at a time mutually agreed upon by the Owner and Contractor.

3.5 CALIBRATION AND START-UP

A. After installation and connection of control components, test, adjust and re-adjust as required all control components in terms of function, design, systems balance and performance. Make systems ready for environmental equipment acceptance tests.

B. After environmental equipment has been accepted and after the systems have operated in normal service for two weeks, check the adjustment on control components and recalibrate where required. Components not in calibration shall be recalibrated to function as required, or shall be
replaced. Control devices, linkages, and other control components shall be calibrated and adjusted for stable and accurate operation in accordance with the design intent and to obtain optimum performance from the equipment controlled. Cause every device to automatically operate as intended to ensure its proper functionality.

3.6 ACCEPTANCE PROCEDURE

A. Upon successful completion of start-up and recalibration as indicated in this section, the Architect shall be requested in writing to inspect the satisfactory operation of the control systems.

B. Demonstrate operation of all control systems, including each individual component, to the Owner and Architect.

C. After correcting all items appearing on the punch list, make a second written request to the Owner and Architect for inspection and approval.

D. After all items on the punch list are corrected and formal approval of the control systems is provided by the Architect, the Contractor shall indicate to the Owner in writing the commencement of the warranty period.

END OF SECTION 15900
SECTION 15950 - TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

1.3 DEFINITIONS

1.4 SUBMITTALS

1.5 QUALITY ASSURANCE

1.6 PROJECT CONDITIONS

1.7 COORDINATION

1.8 WARRANTY

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 PREPARATION

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

3.8 PROCEDURES FOR HYDRONIC SYSTEMS

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

3.11 PROCEDURES FOR MOTORS

3.12 PROCEDURES FOR CONDENSING UNITS

3.13 PROCEDURES FOR HEAT-TRANSFER COILS

3.14 PROCEDURES FOR TEMPERATURE MEASUREMENTS

3.15 FINAL REPORT

3.16 INSPECTIONS

3.17 ADDITIONAL TESTS

1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 15 Section “Mechanical General Requirements.”
2. Division 15 Section “Basic Mechanical Materials and Methods.”
3. Division 15 Section “Common Work Results for HVAC.”

1.2 SUMMARY

A. This Section includes testing, adjusting, and balancing to produce design objectives for the following:

1. Air Systems:
   a. Constant-volume air systems.
   b. Variable-air-volume systems.

2. Hydronic Piping Systems:
   a. Variable-flow systems.
   b. Primary-secondary systems.

3. HVAC equipment quantitative-performance settings.
4. Sound level measuring.
5. Verifying that automatic control devices are functioning properly.
6. Reporting results of activities and procedures specified in this Section.

B. Include rebalancing of air systems, or system portions affected by recommended sheave changes.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. AHJ: Authority having jurisdiction.

C. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

D. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

E. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby
more heat is withdrawn from a person's skin than is normally dissipated.

F. NC: Noise criteria.

G. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

H. RC: Room criteria.

I. Report Forms: Test data sheets for recording test data in logical order.

J. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

K. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

L. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

M. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

N. TAB: Testing, adjusting, and balancing.

O. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

P. Test: A procedure to determine quantitative performance of systems or equipment.

Q. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

A. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 4 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.


D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

E. Sample Report Forms: Submit two sets of sample TAB report forms.

F. Warranties specified in this Section.

1.5 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

B. Smoke Control System Testing: Additional Qualifications: The TAB firm shall be a qualified special inspector for the smoke control systems. The TAB firm for the smoke control system shall have expertise in fire protection engineering, mechanical engineering, and certification as air balancers.

C. Approved Balancing Agencies.

1. The TAB firm selected shall be from the following list:

   a. Absolut Balance Company, Inc.; South Lyon, MI.
   b. Air Solutions, Inc.; Lapeer, MI.
   c. Airflow Testing Inc.; Lincoln Park, MI.
   d. Barmatic Inspecting Co., Inc.; Lincoln Park, MI.
   e. Control Solutions, Inc.; Byron Center, MI.
   f. Ener-Tech Testing; Holly, MI.
   g. Enviro-Aire/Total Balance Co.; St. Clair Shores, MI.
   h. International Test & Balance Inc.; Southfield, MI.
   i. Quality Air Service; Portage, MI.
j. Pro-MEC Engineering Services, Inc.; Grand Ledge, MI.
k. Hi-Tech Test & Balance; Freeland, MI.
l. Integrity Test & Balance, Inc.; Cedar, MI.

D. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:
   a. Submittal distribution requirements.
   c. TAB plan.
   d. Work schedule and Project-site access requirements.
   e. Coordination and cooperation of trades and subcontractors.
   f. Coordination of documentation and communication flow.

E. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.


G. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and
Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

H. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.8 WARRANTY

A. National Project Performance Guarantee: If AABC standards are used, provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:
1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

B. Special Guarantee: If NEBB standards are used, provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

B. Examine system and equipment test reports.

C. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

D. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

E. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.
F. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

G. Examine strainers for clean screens and proper perforations.

H. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

I. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

J. Examine system pumps to ensure absence of entrained air in the suction piping.

K. Examine equipment for installation and for properly operating safety interlocks and controls.

L. Examine automatic temperature system components to verify the following:
   1. Dampers, valves, and other controlled devices are operated by the intended controller.
   2. Dampers and valves are in the position indicated by the controller.
   3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in variable-air-volume terminals.
   4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
   5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
   6. Sensors are located to sense only the intended conditions.
   7. Sequence of operation for control modes is according to the Contract Documents.
   8. Controller set points are set at indicated values.
   9. Interlocked systems are operating.
   10. Changeover from heating to cooling mode occurs according to indicated values.

M. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system
reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:

1. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.


C. Complete system readiness checks and prepare system readiness reports. Verify the following:

1. Permanent electrical power wiring is complete.
2. Hydronic systems are filled, clean, and free of air.
3. Automatic temperature-control systems are operational.
4. Equipment and duct access doors are securely closed.
5. Balance, smoke, and fire dampers are open.
6. Isolating and balancing valves are open and control valves are operational.
7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

C. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts, or use reduced scale contract documents with notations.

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. Cut insulation, and drill ducts for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes with neat patches, neoprene plugs, threaded plugs, or threaded twist-on metal caps, and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

F. Check air flow within intake plenums and mixing boxes of air handling units for uneven flow and temperature stratification and prepare a report with profile elevations (temperature and velocity) on each coil or filter face for Architect.

G. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
H. Verify that motor starters are equipped with properly sized thermal protection.

I. Check dampers for proper position to achieve desired airflow path.

J. Check for airflow blockages.

K. Check condensate drains for proper connections and functioning.

L. Check for proper sealing of air-handling unit components.

M. Check for proper sealing of air duct system.

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.

1. Measure fan static pressures to determine actual static pressure as follows:

   a. Measure outlet static pressure as far downstream from the fan as practicable and upstream from restrictions in ducts such as elbows and transitions.

   b. Measure static pressure directly at the fan outlet.

   c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from flexible connection and downstream from duct restrictions.

   d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.

2. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and treating equipment.

   a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.
3. Measure static pressures entering and leaving other devices such as sound traps, heat recovery equipment, and air washers, under final balanced conditions.

4. Select required sheave sizes and advise installing contractor to change drive sheaves accordingly. Refer to Division 15 Section “Common Work Results for HVAC” for additional requirements.

5. Do not recommend fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full cooling, full heating, economizer, and any other operating modes to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.

1. Measure airflow at a point downstream from the balancing damper and adjust volume dampers until the proper airflow is achieved.

   a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.

2. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure terminal outlets and inlets without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.

2. Adjust patterns of adjustable outlets for proper distribution without drafts.

### 3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

**A. Compensating for Diversity:** When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a maximum set-point airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced airflow terminal units so they are distributed evenly among the branch ducts.

**B. Pressure-Independent, Variable-Air-Volume Systems:** After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set outside-air dampers at minimum, and return- and exhaust-air dampers at a position that simulates full-cooling load.

2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of terminal-unit manufacturer's recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

3. Measure total system airflow. Adjust to within indicated airflow.

4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units as described for constant-volume air systems.

5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow.
a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.

6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outside airflow. Adjust the fan and balance the return-air ducts and inlets as described for constant-volume air systems.

7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.

8. Record the final fan performance data.

3.7 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate.

B. Prepare schematic diagrams of systems' "as-built" piping layouts, or use reduced scale contract documents with notations.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set system controls so automatic valves are wide open to heat exchangers.
6. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
3.8 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.

2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.

3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.

4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.

2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow.
flow and proceeding to the station with the lowest percentage over indicated flow.

3. Record settings and mark balancing devices.

F. Equipment installed with pressure independent characterized control valves (PICCV) or auto-flow devices shall not require hydronic system balancing unless multiple coils are served from a single PICCV or auto-flow device (Example: AHU coil banks with multiple coils). Measure flow through each PICCV and auto-flow device and compare measured value to scheduled value to verify proper valve/device was installed and valve is functional. Verify flow for 100 percent of PICCV and auto-flow devices. Report discrepancies.

G. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

H. Measure the differential-pressure control valve settings existing at the conclusions of balancing, and record in report.

3.9 PROCEDURES FOR VARIABLE-FLOW HYDRONIC SYSTEMS

A. Balance variable-flow hydronic systems by following the "Proportional Balancing Procedure" in accordance with NEBB.

B. 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.

3.10 PROCEDURES FOR PRIMARY-SECONDARY-FLOW HYDRONIC SYSTEMS

A. Balance the primary system crossover flow first, then balance the secondary system.

3.11 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
4. Efficiency rating.
5. Power factor.
6. Nameplate and measured voltage, each phase.
7. Nameplate and measured amperage, each phase.
8. Starter size.
10. Fuse number and size.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass for the controller to prove proper operation. Record observations, including controller manufacturer, model and serial numbers, and nameplate data.

3.12 PROCEDURES FOR CONDENSING UNITS
A. Verify proper rotation of fans.
B. Measure entering- and leaving-air temperatures.
C. Record compressor data.

3.13 PROCEDURES FOR HEAT-TRANSFER COILS
A. Water Coils: Measure the following data for each coil:
   1. Entering- and leaving-water temperature.
   2. Water flow rate.
   3. Water pressure drop.
   4. Dry-bulb temperature of entering and leaving air.
   5. Wet-bulb temperature of entering and leaving air for cooling coils.
   6. Airflow.
   7. Air pressure drop.

B. Refrigerant Coils: Measure the following data for each coil:
   1. Dry-bulb temperature of entering and leaving air.
   2. Wet-bulb temperature of entering and leaving air.
   3. Airflow.
   4. Air pressure drop.
   5. Refrigerant suction pressure and temperature.
3.14 PROCEDURES FOR TEMPERATURE MEASUREMENTS

A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.

B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.15 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. 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, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of TAB firm.
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 firm 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. Notes to explain why certain final data in the body of reports varies from indicated values.
14. Test conditions for fans and pump performance forms including the following:
   a. Settings for outside-, 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. Inlet vane settings for variable-air-volume systems.
   f. Settings for supply-air, static-pressure controller.
   g. Other system operating conditions that affect performance.

E. 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 outside, supply, return, and exhaust airflows.
2. Water flow rates.
3. Terminal units.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:
1. Unit Data: Include the following:
   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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
   j. Number of belts, make, and size.
   k. Number of filters, type, and size.

2. Motor Data:
   a. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
   g. Power factor efficiency.

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. Cooling coil static-pressure differential in inches wg.
   g. Heating coil static-pressure differential in inches wg.
   h. Outside airflow in cfm.
   i. Return airflow in cfm.
   j. Outside-air damper position.
   k. Return-air damper position.
   l. Vortex damper position.

G. 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.
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. Outside-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. Gas Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:

1. Unit Data:

a. System identification.
b. Location.
c. Make and type.
d. Model number and unit size.
e. Manufacturer's serial number.
f. Fuel type in input data.
g. Output capacity in Btuh.
h. Ignition type.
i. Burner-control types.
jk. Motor horsepower and rpm.
k. Motor volts, phase, and hertz.
l. Motor full-load amperage and service factor.
m. Sheave make, size in inches, and bore.
n. Sheave dimensions, center-to-center, and amount of adjustments in inches.
2. Test Data (Indicated and Actual Values):
   
a. Total airflow rate in cfm.
b. Entering-air temperature in deg F.
c. Leaving-air temperature in deg F.
d. Air temperature differential in deg F.
e. Entering-air static pressure in inches wg.
f. Leaving-air static pressure in inches wg.
g. Air static-pressure differential in inches wg.
h. Low-fire fuel input in Btuh.
i. High-fire fuel input in Btuh.
j. Manifold pressure in psig.
k. High-temperature-limit setting in deg F.
l. Operating set point in Btuh.
m. Motor voltage at each connection.
n. Motor amperage for each phase.
o. Heating value of fuel in Btuh.

I. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:
   
a. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
g. Number of belts, make, and size.

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.

J. 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.

K. Air-Terminal-Device Reports:

1. Unit Data:
   a. System and air-handling unit identification.
   b. Location and zone.
   c. Test apparatus used.
   d. Area served.
   e. Air-terminal-device make.
   f. Air-terminal-device number from system diagram.
   g. Air-terminal-device type and model number.
   h. Air-terminal-device size.
   i. Air-terminal-device 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.
L. 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.

M. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Unit make and model number.
   d. Compressor make.
   e. Compressor model and serial numbers.

2. Test Data (Indicated and Actual Values):
   a. Inlet-duct static pressure in inches wg.
   b. Outlet-duct static pressure in inches wg.
   c. Entering-air, dry-bulb temperature in deg F.
   d. Leaving-air, dry-bulb temperature in deg F.
   e. Condenser entering-water temperature in deg F.
   f. Condenser leaving-water temperature in deg F.
   g. Condenser-water temperature differential in deg F.
   h. Condenser entering-water pressure in feet of head or psig.
   i. Condenser leaving-water pressure in feet of head or psig.
j. Condenser-water pressure differential in feet of head or psig.
k. Control settings.
l. Voltage at each connection.
m. Amperage for each phase.
n. Kilowatt input.
o. Crankcase heater kilowatt.
p. Number of fans.
q. Condenser fan rpm.
r. Condenser fan airflow rate in cfm.
s. Condenser fan motor make, frame size, rpm, and horsepower.
t. Condenser fan motor voltage at each connection.
u. Condenser fan motor amperage for each phase.

N. 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 and serial numbers.
   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.

O. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

3.16 INSPECTIONS

A. Initial Inspection:

1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the Final Report.

2. Randomly check the following for each system:

   a. Measure airflow of at least 10 percent of air outlets.
   b. Measure water flow of at least 5 percent of terminals.
   c. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
   d. Measure sound levels at two locations.
   e. Measure space pressure of at least 10 percent of locations.
   f. Verify that balancing devices are marked with final balance position.
   g. Note deviations to the Contract Documents in the Final Report.

B. Final Inspection:

1. After initial inspection is complete and evidence by random checks verifies that testing and balancing are complete and accurately documented in the final
report, request that a final inspection be made by Architect.

2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.

3. Architect shall randomly select measurements documented in the final report to be rechecked. The 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.

4. If the 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."

5. 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.

6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.

7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.

3.17 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing 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 testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 15950
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.
1.2 SUMMARY

A. This Section includes electrical general administrative and procedural requirements. The following requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.3 REFERENCES

A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:

1. A.N.S.I. - American National Standards Institute
2. A.S.T.M. - American Society for Testing Materials
3. I.C.E.A. - Insulated Cable Engineers Association
4. I.E.E.E. - Institute of Electrical and Electronics Engineers
5. N.E.C. - National Electrical Code
6. N.E.C.A. - National Electrical Contractors Association
7. N.E.M.A. - National Electrical Manufacturer's Association
8. U.L. - Underwriters Laboratories, Inc.

1.4 QUALITY ASSURANCE

A. Scope of Work: Furnish all labor, material, equipment, technical supervision, and incidental services required to complete, test and leave ready for operation the electrical systems as specified in the Division 16 Sections and as indicated on Drawings.

1. Contract Documents are complimentary, and what is required by one shall be as binding as if required by all. In the event of inconsistencies or disagreements within the Construction Documents bids shall be based on the most expensive combination of quality and quantity of the work indicated.
2. The Contractor understands that the work herein described shall be complete in every detail.
B. Ordinances and Codes: Perform all Work in accordance with applicable Federal, State and local ordinances and regulations, the Rules and Regulations of NFPA, NECA, and UL, unless otherwise indicated.

1. Notify the Architect/Engineer before submitting a proposal should any changes in Drawings or Specifications be required to conform to the above codes, rules or regulations. After entering into Contract, make all changes required to conform to above ordinances, rules and regulations without additional expense to the Owner.

C. Source Limitations: All equipment of the same or similar systems shall be by the same manufacturer.

D. Tests and Inspections: Perform all tests required by state, city, county and/or other agencies having jurisdiction. Provide all materials, equipment, etc., and labor required for tests.

E. Performance Requirements: Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the trades involved.

F. Sequence and Schedule: Work so as to avoid interference with the work of other trades. Be responsible for removing and relocating any work which in the opinion of the Owner’s Representatives causes interference.

1.5 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for electrical work shall be secured and paid for by the Contractor. All work shall conform to all applicable codes, rules and regulations.

B. Rules of local utility companies shall be complied with. Coordinate with the utility company supplying service to the installation and determine all devices including, but not limited to, all current and potential transformers, meter boxes, C.T. cabinets and meters which will be required and include the cost of all such items and all utilities costs in proposal.
C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed Drawings or diagrams which may be required by the governing authorities. Where the Drawings and/or Specifications indicate materials or construction in excess of code requirements, the Drawings and/or Specifications shall govern.

1.6 DRAWINGS

A. The Drawings show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the Drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes and accessories as may be required to meet such conditions.

C. Deviations from the Drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect/Engineer.

D. The architectural and structural Drawings take precedence in all matters pertaining to the building structure, mechanical Drawings in all matters pertaining to mechanical trades and electrical Drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the Drawings for the various trades, report such conflicts or differences to the Architect/Engineer for resolution.

E. Drawings are not intended to be scaled for rough-in or to serve as shop drawings. Take all field measurements required to complete the Work.

1.7 MATERIAL AND EQUIPMENT MANUFACTURERS

A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of
manufacturers regularly engaged in the production of electrical equipment and shall be of the manufacturer's latest design.

B. If an approved manufacturer is other than the manufacturer used as the basis for design, the equipment or product provided shall be equal in size, quality, durability, appearance, capacity, and efficiency through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system and shall comply with the requirements for Items Requiring Prior Approval specified in this section of the Specifications. All costs to make these items of equipment comply with these requirements including, but not limited to, electrical work, and building alterations shall be included in the original Bid. Similar equipment shall be by one manufacturer.

C. Where existing equipment is modified to include new switches, circuit breakers, metering or other components, the new components shall be by the original equipment manufacturer and shall be listed for installation in the existing equipment. Where original equipment manufacturer components are not available, third party aftermarket components shall be listed for the application and submitted to the engineer for approval. Reconditioned or salvaged components shall not be used unless specifically indicated on the drawings.

1.8 INSPECTION OF SITE

A. Visit the site, examine and verify the conditions under which the Work must be conducted before submitting Proposal. The submitting of a Proposal implies that the Contractor has visited the site and understands the conditions under which the Work must be conducted. No additional charges will be allowed because of failure to make this examination or to include all materials and labor to complete the Work.

1.9 ITEMS REQUIRING PRIOR APPROVAL

A. Bids shall be based upon manufactured equipment specified. All items that the Contractor proposes to use in the Work that are not specifically named in the Contract Documents must be submitted for review prior to bids. Such items
must be submitted in compliance with Division 1 specifications. Requests for prior approval must be accompanied by complete catalog information, including but not limited to, model, size, accessories, complete electrical information and performance data in the form given in the equipment schedule on the drawings at stated design conditions. Where items are referred to by symbolic designations on the drawings, all requests for prior approval shall bear the same designations.

1. Equipment to be considered for prior approval shall be equal in quality, durability, appearance, capacity and efficiency through all ranges of operation, shall fulfill the requirements of equipment arrangement and space limitations of the equipment shown on the plans and/or specified and shall be compatible with the other components of the system.

2. All costs incurred to make equipment comply with other requirements, including providing maintenance, clearance, electrical, replacement of other components, and building alterations shall be included in the original bid.

B. Voluntary alternates may be submitted for consideration, with listed addition or deduction to the bid.

1.10 SHOP DRAWINGS/SUBMITTALS

A. Submit project-specific submittals for review in compliance with Division 1.

B. All shop Drawings shall be submitted in groupings of similar and/or related items (lighting fixtures, switchgear, etc.). Incomplete submittal groupings will be returned unchecked.

C. Provide detailed layout shop Drawings (on transparent media) of all lighting and power distribution systems, routing of conduits, combining of circuits, circuiting, details and related information necessary of installation and maintenance. After review by the Architect/Engineer, a copy of Drawings will be stamped and returned to the Contractor.

D. If deviations (not substitutions) from Contract Documents are deemed necessary by the Contractor, details of such deviations, including changes in related portions of the
E. Submit for approval shop drawings for all electrical systems or equipment but not limited to the items listed below. Where items are referred to by symbolic designation on the Drawings and Specifications, all submittals shall bear the same designation (light fixtures). Refer to other sections of the electrical Specifications for additional requirements.

1. Cable Trays
2. Wiring Devices
3. Lighting Control Devices
4. Packaged Engine Generators
5. Enclosed Switches and Circuit Breakers
6. Transfer Switches
7. Enclosed Controllers
8. Switchboards
9. Panelboards
10. Dry Type Transformers (600 V and Less)
11. Fuses
12. Interior Lighting
13. Exterior Lighting
14. Fire Alarm
15. Underground Duct and Utility Structures

1.11 COORDINATION DRAWINGS

A. Submit project specific coordination drawings for review in compliance with Division 1 Specification Sections.

1.12 OPERATION AND MAINTENANCE INSTRUCTIONAL MANUALS

A. Submit project specific Operation and Maintenance Instructional Manuals for review in compliance with Division 1 Specification Sections.

B. Provide complete operation and maintenance instructional manuals covering all electrical equipment herein specified, together with parts lists. Maintenance and operating instructional manuals shall be job specific to this project. Generic manuals are not acceptable. Four (4) copies of all literature shall be furnished for Owner and shall be bound in ring binder form. Maintenance and operating instructional manuals shall be provided when construction is approximately 75% complete.
C. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:

1. Routine maintenance procedures.
2. Trouble-shooting procedures.
3. Contractor's telephone numbers for warranty repair service.
5. Recommended spare parts lists.
6. Names and telephone numbers of major material suppliers and subcontractors.
7. System schematic drawings on 8-1/2" x 11" sheets.

1.13 RECORD DRAWINGS

A. Submit record drawings in compliance with Division 1.

B. Contractor shall submit to the Architect/Engineer, record drawings on electronic media which have been neatly marked to represent as-built conditions for all new electrical work.

C. The Contractor shall keep accurate note of all deviations from the construction documents and discrepancies in the underground concealed conditions and other items of construction on field drawings as they occur. The marked up field documents shall be available for review by the Architect, Engineer and Owner at their request.

1.14 INSTRUCTION OF OWNER PERSONNEL

A. Before final inspection, instruct Owner's designated personnel in operation, adjustment, and maintenance of electrical equipment and systems at agreed upon times. A minimum of 8 hours of formal instruction to Owner's personnel shall be provided for each building. Additional hours are specified in individual specification sections.

B. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

C. In addition to individual equipment training provide overview of each electrical system. Utilize the as-built documents for this overview.
D. Prepare and insert additional data in operation and maintenance manual when need for such data becomes apparent during instruction, or as requested by Owner.

1.15 WARRANTY

A. Warranty: Comply with the requirements in Division 1 Specification Sections. Contractor shall warranty that the electrical installation is free from defects and agrees to replace or repair, to the Owner’s satisfaction, any part of this electrical installation which becomes defective within a period of one year (unless specified otherwise in other Division 16 sections) from the date of substantial completion following final acceptance, provided that such failure is due to defects in the equipment, material, workmanship or failure to follow the contract documents.

B. Contractor shall be responsible for any temporary services including equipment and installation required to maintain operation as a result of any equipment failure or defect during warranty period.

C. File with the Owner any and all warranties from the equipment manufacturers including the operating conditions and performance capacities they are based on.

1.16 USE OF EQUIPMENT

A. The use of any equipment, or any part thereof for purposes other than testing even with the Owner's consent, shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.

B. Do not use Owner's lamps for temporary lighting except as allowed and directed by the Owner. Equip lighting fixtures with new lamps when the project is turned over to the Owner.

1.17 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:

1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.

3. To allow right of way for piping and conduit installed at required slope.

4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate location of access panels and doors for electrical items that are behind finished surfaces or otherwise concealed. Access doors and panels are specified in Division 8 Section "Access Doors and Frames."

D. Coordinate electrical testing of electrical, mechanical, and architectural items, so equipment and systems that are functionally interdependent are tested to demonstrate successful interoperability.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to raceways and piping systems installed at a required slope.
3.2 DEMOLITION WORK

A. All demolition of existing electrical equipment and materials will be done by this Contractor unless otherwise indicated. Include all items such as, but not limited to, electrical equipment, devices, lighting fixtures, conduit, and wiring called out on the Drawings and as necessary whether such items are actually indicated on the Drawings or not in order to accomplish the installation of the specified new work.

B. In general, demolition work is indicated on the Drawings. However, the Contractor shall visit the job site to determine the full extent and character of this work.

C. Unless specifically noted to the contrary, removed materials shall not be reused in the work. Salvaged materials that are to be reused shall be stored safe against damage and turned over to the appropriate trade for reuse. Salvaged materials of value that are not to be reused shall remain the property of the Owner unless such ownership is waived. Items on which the Owner waives ownership shall become the property of the Contractor, who shall remove and legally dispose of same, away from the premises.

D. Where equipment or fixtures are removed, outlets shall be properly blanked off, and conduits capped. After alterations are done, the entire installation shall present a "finished" look, as approved by the Architect/Engineer. The original function of the present electrical work to be modified shall not be changed unless required by the specific revisions to the system as specified or as indicated.

E. Reroute signal wires, lighting and power wiring as required to maintain service. Where walls and ceilings are to be removed as shown on the Drawings, the conduit is to be cut off by the Electrical Trades so that the abandoned conduit in these walls and ceilings may be removed with the walls and ceilings by the Architectural Trades. All dead-end conduit runs shall be plugged at the remaining line outlet boxes or at the panels.

F. Where new walls and/or floors are installed which interfere with existing outlets, devices, etc., the
Electrical Trades shall adjust, extend and reconnect such items as required to maintain continuity of same.

G. All electrical work in altered and unaltered areas shall be run concealed wherever possible. Use of surface raceway or exposed conduits will be permitted only where approved by the Architect/Engineer.

H. Existing lighting shall be reused where indicated on plans. Reused fixtures shall be detergent cleaned, relamped and reconditioned suitable for satisfactory operation and appearance.

3.3 INSTALLATION OF EQUIPMENT

A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the Drawings and Specifications, report such conflicts to the Architect/Engineer for resolution.

B. Device Location:

1. Allow for relocation prior to installation of wiring devices and other control devices, for example, receptacles, switches, fire alarm devices, and access control devices, within a 10-foot radius of indicated location without additional cost.

3.4 WORK IN EXISTING BUILDINGS

A. The Owner will provide access to existing buildings as required. Access requirements to occupied buildings shall be identified on the project schedule. The Contractor, once Work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.

B. Adequately protect and preserve all existing and newly installed Work. Promptly repair any damage to same at Contractor's expense.

C. Consult with the Owner’s Representative as to the methods of carrying on the Work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all service lines shall be kept in operation as long as possible and the services shall only be
interrupted at such time as will be designated by the Owner's Representative.

3.5 TEMPORARY SERVICES

A. Provide and remove upon completion of the project, in accordance with the general conditions and as described in Division 1, a complete temporary electrical and telephone service during construction.

3.6 DISPOSAL

A. Fluorescent Lamps

1. Fluorescent lamps are known to contain mercury and are classified as hazardous material. All fluorescent lamps shall be assumed to contain mercury unless tested and confirmed otherwise with a toxicity characteristic leaching procedure (TCLP).

2. Hazardous materials (fluorescent lamps), shall be sent to a lamp recycling facility. The materials shall be properly packaged with labels that meet the Department of Transportation Regulations and stored in a secure location prior to transportation.

3. The Contractor shall identify the costs of the lamp disposal process including, but not limited to, the lamp packaging, storage, transportation, disposal, and any profile fees.

4. At the completion of the project, provide documentation to verify that the lamps have been properly disposed of in accordance with all local, state and federal guidelines.

B. Ballasts

1. Lighting ballasts manufactured prior to 1979 have been known to contain polychlorinated biphenyls (PCBs). Unless specifically noted on the ballast as containing "No PCBs," the ballast shall be assumed to contain components with PCB materials.

2. Hazardous materials (ballasts with PCBs), shall be disposed of at a hazardous waste incineration facility, or at a recycling facility in accordance with the Code of Federal Regulations as administered by the EPA in regards to this issue. The ballasts shall be packaged/stored in fifty-five gallon steel
drums with labels that meet the Department of Transportation Regulations.

3. The Contractor shall identify the costs of the ballast disposal process including, but not limited to, the packaging, storage, transportation, disposal, and any profile fees.

4. Provide at completion of the project documentation (manifests) to verify that the ballasts have properly been disposed of in accordance with all local, state and federal guidelines.

3.7 CHASES AND RECESSES

A. Provided by the architectural trades, but the Contractor shall be responsible for their accurate location and size.

3.8 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

A. Refer to General Conditions for requirements.

B. All cutting, patching and repair work shall be performed by the Contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.9 EXCAVATION AND BACKFILLING

A. Provide all excavation, trenching, tunneling, dewatering and backfilling required for the electrical work. Coordinate the work with other excavating and backfilling in the same area.

B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical Drawings.

C. Backfill all excavations with well-tamped granular material. Backfill all excavations under wall footings with lean mix concrete up to underside of footings and extend concrete within excavation a minimum of four (4) feet each side of footing. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.
D. Backfill all excavations inside building, under drives and parking areas with well-tamped granular material. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

E. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction as specified above. Backfill remainder of excavation with unfrozen, excavated material in such a way to prevent settling.

3.10 EQUIPMENT CONNECTIONS

A. Make connections to equipment, motors, lighting fixtures, and other items included in the work in accordance with the approved shop Drawings and rough-in measurements furnished by the manufacturers of the particular equipment furnished. All additional connections not shown on the Drawings, but called out by the equipment manufacturer's shop Drawings shall be provided.

3.11 CLEANING

A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.

B. Final cleanup shall include, but not be limited to, washing of fixture lenses or louvers, switchboards, substations, motor control centers, panels, etc. Fixture reflectors and lenses or louvers shall be left with no water marks or cleaning streaks.

3.12 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

A. Equipment and materials shall be protected from theft, injury or damage.

B. Protect conduit openings with temporary plugs or caps.

C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect/Engineer. Equipment set in place in unprotected areas must be provided with temporary protection.
3.13 EXTRA WORK

A. For any extra electrical work which may be proposed, this Contractor shall furnish to the General Contractor, an itemized breakdown of the estimated cost of the materials and labor required to complete this work. The Contractor shall proceed only after receiving a written order from the General Contractor establishing the agreed price and describing the work to be done. Prior to any extra work which may be proposed, the Electrical Contractor shall submit unit prices (same prices for increase/decrease of work) for the following items: 1/2", 3/4", 1", 1-1/2" conduit; #12, #10, #8, #6, #2 wire; receptacle, I.G. receptacle, data box, fire alarm combination visual/audible notification appliance, fire alarm visual notification appliance, clock, or other devices which may be required for any proposed extra work.

3.14 DRAWINGS AND MEASUREMENTS

A. The Drawings are not intended to be scaled for rough-in measurements nor to serve as Shop Drawings. Field measurements necessary for ordering materials and fitting the installation to the building construction and arrangement are the Contractor’s responsibility. The Contractor shall check latest Architectural Drawings and locate light switches from same where door swings are different from Electrical Drawings.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SCOPE
A. The contractor shall furnish short-circuit and protective device coordination studies as prepared by the electrical equipment manufacturer.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per the requirements set forth in NFPA 70E –Standard for Electrical Safety in the Workplace. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D prepared by the electrical equipment manufacturer.
C. The scope of the studies shall include all new distribution equipment supplied by the equipment Manufacturer under this contract as well as all directly affected existing distribution equipment at the customer facility (shared transformer with police department).

D. Provide a separate cost estimate for separate studies to include all existing distribution equipment at the customer’s Police Department facility. Coordinate specifics of scope and access to existing facility, and as-built documents with Project Manager/Owner.

1.3 REFERENCES

A. Institute of Electrical and Electronics Engineers, Inc. (IEEE):

1. IEEE 141 – Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
2. IEEE 242 – Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
3. IEEE 399 – Recommended Practice for Industrial and Commercial Power System Analysis

B. American National Standards Institute (ANSI):

1. ANSI C57.12.00 – Standard General Requirements for Liquid-Immersed Distribution, Power, and Regulating Transformers
2. ANSI C37.13 – Standard for Low Voltage AC Power Circuit Breakers Used in Enclosures
3. ANSI C37.010 – Standard Application Guide for AC High Voltage Circuit Breakers Rated on a Symmetrical Current Basis
C. The National Fire Protection Association (NFPA)

1. NFPA 70 - National Electrical Code, latest edition
2. NFPA 70E - Standard for Electrical Safety in the Workplace

1.4 SUBMITTALS FOR REVIEW/APPROVAL

A. The short-circuit and protective device coordination studies shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.

1.5 SUBMITTALS FOR CONSTRUCTION

A. The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Five (5) bound copies of the complete final report shall be submitted. Additional copies of the short-circuit input and output data, where required, shall be provided on CD in PDF format.

B. The report shall include the following sections:

1. Executive Summary.
2. Descriptions, purpose, basis and scope of the study.
3. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties.
4. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
5. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
6. Details of the incident energy and flash protection boundary calculations.
7. Recommendations for system improvements, where needed.
8. One-line diagram.
C. Arc flash labels shall be provided in hard copy and a copy of the computer analysis software viewer program is required to provide arc flash labels in electronic format.

1.6 QUALIFICATIONS

A. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

B. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer.

C. The Registered Professional Electrical Engineer shall have a minimum of five (5) years of experience in performing power system studies.

D. The equipment manufacturer shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least ten actual arc flash hazard analysis it has performed in the past year.

1.7 COMPUTER SOFTWARE PROGRAMS

A. Computer Software Programs: Subject to compliance with requirements, provide products by one of the following:

1. EDSA Micro Corporation.
2. SKM Systems Analysis, Inc.
3. ESA Inc.
4. CGI CYME.
5. Operation Technology, Inc.

PART 2 - PRODUCTS

2.1 STUDIES

A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer.

B. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E - Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D prepared by the equipment manufacturer.
2.2 DATA COLLECTION

A. Contractor shall furnish all data as required by the power system studies. The Engineer performing the short-circuit; protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data immediately after award of the contract. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.

B. Source combination may include present and future motors and generators.

C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner.

D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data to satisfy the study requirements.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY


B. Transformer design impedances shall be used when test impedances are not available.

C. Provide the following:

1. Calculation methods and assumptions
2. Selected base per unit quantities
3. One-line diagram of the system being evaluated
4. Source impedance data, including electric utility system and motor fault contribution characteristics
5. Tabulations of calculated quantities
6. Results, conclusions, and recommendations.

D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

1. Electric utility’s supply termination point
2. Incoming switchgear
3. Unit substation primary and secondary terminals
4. Low voltage switchgear
5. Motor control centers
6. Standby generators and automatic transfer switches
7. Branch circuit panelboards
8. Other significant locations throughout the system.

E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.

F. Protective Device Evaluation:

1. Evaluate equipment and protective devices and compare to short circuit ratings
2. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses
3. Notify design engineer in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.

2.4 PROTECTIVE DEVICE COORDINATION STUDY

A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.

C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

E. Plot the following characteristics on the TCC graphs, where applicable:

1. Electric utility’s overcurrent protective device
2. Medium voltage equipment overcurrent relays
3. Medium and low voltage fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands
4. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
5. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves
6. Conductor damage curves
7. Ground fault protective devices, as applicable
8. Pertinent motor starting characteristics and motor damage points, where applicable
9. Pertinent generator short-circuit decrement curve and generator damage point
10. The largest feeder circuit breaker in each motor control center and applicable panelboard.

F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.5 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-2004, Annex D.

B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, busway and splitters) where work could be performed on energized parts.

C. The Arc-Flash Hazard Analysis shall include all significant locations in 240 volt and 208 volt systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.

D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm2.

E. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:

1. Fault contribution from induction motors should not be considered beyond 3-5 cycles.
2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).

H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.

I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
J. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.

K. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.6 REPORT SECTIONS

A. Input data shall include, but not be limited to the following:

1. Feeder input data including feeder type (cable or bus), size, length, number per phase, conduit type (magnetic or non-magnetic) and conductor material (copper or aluminum).
2. Transformer input data, including winding connections, secondary neutral-ground connection, primary and secondary voltage ratings, kVA rating, impedance, % taps and phase shift.
3. Generation contribution data, (synchronous generators and Utility), including short-circuit reactance (X''d), rated MVA, rated voltage, three-phase and single line-ground contribution (for Utility sources) and X/R ratio.
4. Motor contribution data (induction motors and synchronous motors), including short-circuit reactance, rated horsepower or kVA, rated voltage, and X/R ratio.

B. Short-Circuit Output Data shall include, but not be limited to the following reports:

1. Low Voltage Fault Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:
a. Voltage
b. Calculated fault current magnitude and angle
c. Fault point X/R ratio
d. Equivalent impedance

2. Momentary Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

a. Voltage
b. Calculated symmetrical fault current magnitude and angle
c. Fault point X/R ratio
d. Calculated asymmetrical fault currents
   1) Based on fault point X/R ratio
   2) Based on calculated symmetrical value multiplied by 1.6
   3) Based on calculated symmetrical value multiplied by 2.7
e. Equivalent impedance

3. Interrupting Duty Report shall include a section for three-phase and unbalanced fault calculations and shall show the following information for each applicable location:

a. Voltage
b. Calculated symmetrical fault current magnitude and angle
c. Fault point X/R ratio
d. No AC Decrement (NACD) Ratio
e. Equivalent impedance
f. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a symmetrical basis
g. Multiplying factors for 2, 3, 5 and 8 cycle circuit breakers rated on a total basis

C. Recommended Protective Device Settings:

1. Phase and Ground Relays:
   a. Current transformer ratio
   b. Current setting
c. Time setting
d. Instantaneous setting

2. Circuit Breakers:

   a. Adjustable pickups and time delays (long time, short time, ground)
   b. Adjustable time-current characteristic
   c. Adjustable instantaneous pickup
   d. Recommendations on improved trip systems, if applicable.

D. Incident energy and flash protection boundary calculations

   1. Arcing fault magnitude
   2. Protective device clearing time
   3. Duration of arc
   4. Arc flash boundary
   5. Working distance
   6. Incident energy
   7. Hazard Risk Category
   8. Recommendations for arc flash energy reduction

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

   A. The contractor shall adjust relay and protective device settings according to the recommended settings table provided by the coordination study.

   B. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.

   C. Notify design engineer in writing of any required major equipment modifications.

3.2 ARC FLASH WARNING LABELS

   A. The contractor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.

   B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the
analysis have been presented to the owner and after any system changes, upgrades or modifications have been incorporated in the system.

C. The label shall include the following information, at a minimum:

1. Location designation
2. Nominal voltage
3. Flash protection boundary
4. Hazard risk category
5. Incident energy
6. Working distance
7. Engineering report number, revision number and issue date.

D. Labels shall be machine printed, with no field markings.

E. Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.

1. For each 480 and applicable 208 volt panelboard, one arc flash label shall be provided.
2. For each motor control center, one arc flash label shall be provided.
3. For each low voltage switchboard, one arc flash label shall be provided.
4. For each switchgear, one flash label shall be provided.
5. For medium voltage switches one arc flash label shall be provided.

F. Labels shall be field installed by the contractor.

END OF SECTION 16055
SECTION 16060 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

B. Related Sections include the following:

1. Division 16 Section “Electrical General Requirements”.
2. Division 16 Section “Conductors and Cables”.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

2.2 GROUNDING CONDUCTORS

2.3 CONNECTOR PRODUCTS

2.4 GROUNDING ELECTRODES

PART 3 - EXECUTION

3.1 EQUIPMENT GROUNDING

3.2 CONNECTIONS

3.3 INSTALLATION

3.4 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

3.5 TELECOMMUNICATIONS GROUNDING

3.6 FIELD QUALITY CONTROL

3.7 GRADING AND PLANTING
1.3 REFERENCES

A. ASTM B 3: Specification for Soft or Annealed Copper Wire.

B. ASTM B 8: Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard or Soft.

C. ASTM B 33: Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes.


K. NFPA 70B: Recommended Practice for Electrical Equipment Maintenance.

L. TIA/EIA 607: Commercial Building Grounding and Bonding Requirements Standard.

M. UL 467: Grounding and Bonding Equipment.

N. UL 486 A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

O. UL 486B: Wire Connectors for Use with Aluminum Conductors.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Data: For the following:
1. Ground rods.

C. Qualification Data: For firms and persons specified in "Quality Assurance" Article.

D. Field Test Reports: Submit written test reports to include the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
4. Indicate overall system resistance to ground.
5. Indicate overall Telecommunications system resistance to ground.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 16 "Electrical General Requirements".

B. Accurately record actual locations of grounding electrodes and connections to building steel.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Refer to specification section "Electrical Testing."

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1. Comply with UL 467.

C. Comply with NFPA 70; for overhead-line construction and medium-voltage underground construction, comply with IEEE C2.

D. Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system.

E. Comply with ANSI/TIA/EIA-607 "Standard for Commercial Building Grounding and Bonding Requirements for Telecommunications".

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Grounding Conductors and Cables:
   a. Refer to Division 16 Section “Conductors and Cables”.

2. Grounding Rods:
   b. Apache Grounding/Erico Inc.
   c. Chance/Hubbell.

3. Mechanical Connectors:
   b. Burndy.
   c. Chance/Hubbell.

4. Exothermic Connections:
   a. Cadweld.

2.2 GROUNDING CONDUCTORS

A. For insulated conductors, comply with Division 16 Section "Conductors and Cables."

B. Equipment Grounding Conductors: Insulated with green-colored insulation.

C. Grounding Electrode Conductors: Stranded cable.

D. Underground Conductors: Bare, tinned, stranded, copper unless otherwise indicated.

E. Bare Copper Conductors: Comply with the following:
F. Copper Bonding Conductors: As follows:
   1. Bonding Conductor: Stranded copper conductor; size per the NEC.
   2. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; size per the NEC.

G. Grounding Bus: Bare, annealed copper bars of rectangular cross section, with insulators.

H. Telecommunications Main Grounding Busbar (TMGB)
   1. 48" (min) x 4" x ¼" tin plated, copper busbar with three rows of ¼ x 20 tapped holes 3" on center.

I. Telecommunications Grounding Busbar (TGB)
   1. 12" (min) x 2" x ¼" tin plated, copper busbar with two rows of ¼ x 20 tapped holes 3" on center.

J. Telecommunications Bonding Backbone (TBB)
   1. Minimum No. 2 AWG insulated stranded copper.

K. Telecommunications Bonding Conductors
   1. Minimum No. 6 AWG insulated stranded copper.

2.3 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected for the specific application per manufacturer's written instructions.

D. Compression-Type Connectors: Pure, wrought copper, per ASTM B187.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel.
PART 3 – EXECUTION

3.1 EQUIPMENT GROUNDING

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Underground Grounding Conductors: No. 2/0 AWG minimum. Bury at least 24 inches below grade or bury 12 inches above duct bank when installed as part of the duct bank.

C. In raceways, use insulated equipment grounding conductors.

D. Install equipment grounding conductors in all feeders and circuits. Terminate each end on suitable lugs, bus or bushing.

E. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

F. Air-Duct Equipment Circuits: Install an equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners and heaters. Bond conductor to each unit and to air duct.

G. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate equipment grounding conductor to each electric water heater, heat-tracing, and antifrost heating cable. Bond conductor to heater units, piping, connected equipment, and components.

H. Metal Poles Supporting Outdoor Lighting Fixtures: Provide a separate equipment grounding conductor with supply branch-circuit conductors. Bond pole and foundation reinforcing steel to equipment ground conductor.

I. Verify specific equipment grounding requirements with the manufacturer’s recommendations.
3.2 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. 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 ensure high conductivity and to make contact points closer to order of galvanic series.
2. Make connections with clean, bare metal at points of contact.
5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells. Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations

1. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.
2. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.
E. Connections at Test Wells: Use compression-type connectors on conductors and make bolted- and clamped-type connections between conductors and ground rods.

F. Tighten screws and bolts for grounding and bonding connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

G. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

H. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.3 INSTALLATION

A. Equipotential Ground: Interconnect grounding electrodes to form one, electrically continuous, equipotential grounding electrode system. Grounding electrodes to be interconnected include:

1. Ground rods.
2. Ufer ground.
3. Metal water service pipe.

B. Ground Rods: Install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes.

1. Verify that final backfill and compaction has been complete before driving ground rods.
2. Drive ground rods until tops are 2 inches below finished floor or final grade, unless otherwise indicated.
3. Interconnect ground rods with grounding electrode conductors. Use exothermic welds, except at test wells and as otherwise indicated. Make connections without exposing steel or damaging copper coating.
C. Ufer Ground (Concrete-Encased Grounding Electrode):
Fabricate according to NFPA 70, Paragraph 250-81(c):

1. Provide a minimum of 20 feet of bare copper conductor not smaller than No. 4 AWG. If concrete foundation is less than 20 feet long, coil excess conductor within the base of the foundation.
2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts.
3. Extend grounding conductor below grade and connect to building grounding grid or to a grounding electrode external to concrete.

D. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage. Install in conduit where routed above grade.

E. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

F. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

G. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with grounding clamp connectors.

H. Bond each aboveground portion of gas piping system upstream from equipment shutoff valve.
I. Separately Derived AC Power Systems: Ground separately-derived AC power system neutrals including distribution transformers to grounding electrodes per NFPA 70.

J. Packaged Engine Generator: Solidly ground the packaged engine generator neutral to the normal power source neutral. Do not ground the generator neutral to a separate grounding electrode.

K. Install one test well for each service at the ground rod electrically closest to the service entrance. Set top of well flush with finished grade or floor.

L. Grounding Bus:

1. Install grounding bus in the locations listed below and elsewhere as indicated:
   a. Electrical equipment rooms.
   b. Telephone equipment rooms.
   c. Rooms housing service equipment.

2. Use insulated spacer; space 1 inch from wall and support from wall 6 inches above finished floor, unless otherwise indicated.

M. Equipment Grounding: Provide a permanent and continuous bonding of conductor enclosures, equipment frames, power distribution equipment ground busses, cable trays, metallic raceways, and other non-current carrying metallic parts of the electrical system.

N. Provide a flexible braid bonding jumper at each set of columns at expansion joints.

3.4 UNDERGROUND DISTRIBUTION SYSTEM GROUNDING

A. Manholes and Handholes: Install a driven ground rod close to wall, inside manhole, and set rod depth so 4 inches will extend above finished floor. If necessary, install ground rod before manhole is placed and provide a No. 1/0 AWG conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive tape or heat-shrunk insulating sleeve from 2 inches above to 6 inches below concrete. Seal floor opening with waterproof, nonshrink grout.
B. Connections to Manhole Components: Connect all exposed-metal parts, such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum conductor. Train conductors level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields as recommended by manufacturer of splicing and termination kits.

C. Pad-Mounted Transformers and Switches: Install two ground rods and counterpoise circling pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with transformers/substations by connecting them to underground cable and grounding electrodes. Use not less than a No. 2 AWG conductor for counterpoise and for taps to equipment ground pad. Bury counterpoise not less than 18 inches below grade and 6 inches from the foundation.

3.5 TELECOMMUNICATIONS GROUNDING

A. Telecommunications Grounding System: The telecommunications grounding system shall consist of:

1. Telecommunications Main Grounding Busbar (TMGB) located in the main telecommunications room near the telecommunications service entrance. Bond to the main building electrical grounding electrode system via a No. 3/0 AWG copper ground conductor.

2. A Telecommunications Grounding Busbar (TGB) in each telecommunications room, cabinets, etc.

3. A Telecommunications Bonding Backbone (TBB) tying together the TMGB and each TGB.

4. Bonding of all equipment racks, raceways, non-current carrying metallic equipment and surge protection devices within the telecommunications room to the TGB’s or TMGB using approved bonding conductors. Each piece of equipment shall be bonded individually directly to the ground bus.

B. All bonding connections shall be installed at an accessible location for inspection and maintenance.

C. All telecommunications bonding connections shall be of an approved mechanical type connection. Do not use exothermic welds unless specifically indicated on the Drawings.
D. The physical routing shall, in general, follow the same path as the backbone cable system.

E. Bond each TGB directly to the building steel with a No. 6 AWG conductor.

F. Do not use TGB’s as a power system ground connection unless specifically noted on the Drawings.

G. All bonding connectors and conductors shall be UL listed for the purpose intended.

H. Mount TMGB and TGB bus to backboard or wall using 2” standoff insulators.

I. Individually bond each piece of non-current carrying metallic equipment in the Telecommunications Room to the TGB.

J. Install continuous cable from the TMGB to the furthest TGB. Bond all TGB’s to TBB with bare No. 3/0 AWG copper ground conductor and T-tap grounding hardware.

3.6 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality control tests in accordance with Division 16 section “Electrical Testing”

1. Inspect grounding and bonding system conductors and connections for tightness and proper installation and for compliance with the Drawings and Specifications.
2. After installing grounding system but before permanent electrical circuitry has been energized, test for compliance with requirements.

   a. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal.
   b. Measure ground resistance not less than two full days after the last trace of precipitation, and without the soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
c. Perform tests, by the fall-of-potential method according to IEEE 81. Instrumentation utilized shall be as defined in Section 12 of IEEE 81 and shall be specifically designed for ground impedance testing. Provide sufficient spacing so that curves flatten in the 62% area of the distance between the item under test and the current electrode.

3. Provide drawings locating each ground rod and ground rod assembly and other grounding electrodes, identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

   a. Equipment Rated 500 kVA and Less: 10 ohms.
   b. Equipment Rated 500 to 1000 kVA: 5 ohms.
   c. Equipment Rated More Than 1000 kVA: 3 ohms.
   e. Manhole Grounds: 10 ohms.
   f. The telecommunications grounding system shall have a maximum resistance of 1 ohm as measured from the TMGB ground to earth ground.

4. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.
3.7 GRADING AND PLANTING

A. Restore surface features, including vegetation, at areas disturbed by Work of this Section. Reestablish original grades, unless otherwise indicated. If sod has been removed, replace it as soon as possible after backfilling is completed. Restore areas disturbed by trenching, storing of dirt, cable laying, and other activities to their original condition. Include application of topsoil, fertilizer, lime, seed, sod, sprig, and mulch. Comply with Division 2 Section "Landscaping." Maintain restored surfaces. Restore disturbed paving as indicated.

END OF SECTION 16060
SECTION 16073 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.
C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times the applied force.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit.
   b. Cooper B-Line, Inc.; a division of Cooper Industries.
   c. ERICO International Corporation.
   d. GS Metals Corp.
   e. Thomas & Betts Corporation.
   f. Unistrut; Tyco International, Ltd.
   g. Wesanco, Inc.

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

3. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

   1. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities
appropriate for supported loads and building materials in which used.

a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1) Cooper B-Line, Inc.; a division of Cooper Industries.
2) Empire Tool and Manufacturing Co., Inc.
3) Hilti Inc.
4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
5) MKT Fastening, LLC.

2. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

4. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

5. Toggle Bolts: All-steel springhead type.


2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Division 05 Section "Metal Fabrications" for steel shapes and plates.

2.3 ROOF MOUNTED CONDUIT AND EQUIPMENT SUPPORTS

A. General: Shop- or field- fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted conduit and equipment.

B. Adjustable Compact Stand: Recycled rubber base unit with integral threaded coupling capable of accepting 3/8-16 threaded rod, or 1-5/8 inch by 1-5/8 inch metal strut and various supporting elements.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. B-Line Systems, Inc.; a division of Cooper Industries; Dura-Blok.
   b. ERICO International Corp.; Caddy Pyramid.
   c. Tolco; a brand of Nibco; Pipe Piers.

C. Low-Type, Single-Conduit Stand: Assembly of base and horizontal members, and support, for roof installation without membrane penetration.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. B-Line Systems, Inc.; a division of Cooper Industries; Dura-Blok.
      b. ERICO International Corp.; Caddy Pyramid.
      c. Tolco; a brand of Nibco; Pipe Piers.

   3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with standard strut clamps and accessories.

D. Low-Type, Multiple-Conduit Stand: Assembly of two or more bases and horizontal members, and supports, for roof installation without membrane penetration.

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. B-Line Systems, Inc.; a division of Cooper Industries; Dura-Blok.
      b. ERICO International Corp.; Caddy Pyramid.
      c. Tolco; a brand of Nibco; Pipe Piers.

   3. Horizontal Member: Cadmium-plated-steel or galvanized-steel strut designed for use with threaded rod, standard strut clamps, and accessories.

E. High-Type, Multiple-Conduit and Equipment Stand: Assembly of bases, vertical and horizontal members, and pipe...
supports, for roof installation without membrane penetration.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. B-Line Systems, Inc.; a division of Cooper Industries; Dura-Blok.
   b. ERICO International Corp.; Caddy Pyramid.
   c. Tolco; a brand of Nibco; Pipe Piers.

2. Bases: One or more recycled rubber.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.

2.4 BACKBOARDS

A. Backboards: Plywood, fire-retardant treated, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 6 Section "Rough Carpentry." Plywood sheets shall be free of all voids. Plywood shall have a minimum of two coats of fire-resistant, non-conducting paint applied to all sides of all sheets. Provide flush hardware and supports to mount plywood to wall. The provided hardware shall have sufficient strength to carry all anticipated loads including, but not limited to cabling, cable management and equipment racks.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted support system, sized so
capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with:
   a. Two-bolt conduit clamps
   b. Single-bolt conduit clamps
   c. Single-bolt conduit clamps using spring friction action for retention in support channel.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb.

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.
2. To New Concrete: Bolt to concrete inserts.
3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
4. To Existing Concrete: Expansion anchor fasteners.
5. To Steel:
   a. Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts.
   b. Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69
   c. Spring-tension clamps.

6. To Light Steel: Sheet metal screws.
7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel support systems attached to substrate.

E. Slotted support systems applications:

1. Indoor dry and damp Locations: Painted Steel
2. Outdoors and interior wet locations: Galvanized Steel
3. Corrosive Environments, including pool equipment rooms: Nonmetallic

F. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

G. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

H. Obtain permission from Architect/Engineer before using powder-actuated anchors.

I. Obtain permission from Architect/Engineer before drilling or cutting structural members.

J. Fabricate supports from structural steel or steel channel. Rigidly weld members or use hexagon head bolts to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.

K. Install surface-mounted cabinets and panelboards with minimum of four anchors.

L. In wet and damp locations use steel channel supports to stand cabinets and panelboards one inch off wall.

M. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

N. The Contractor shall replace all supports and channels that sag, twist, and/or show signs of not providing proper structural support, to the equipment, it is intended for, as determined by the Owner and Architect/Engineer. All costs associated with replacing supports and steel channels shall be incurred by the Contractor.
3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Division 05 Section "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 INSTALLATION OF ROOF MOUNTED SUPPORTS

A. Install in accordance with manufacturer’s instructions.

B. If gravel top roof, gravel must be removed around and under support.

C. Consult roofing manufacturer for roof membrane compression capacities. If required, a compatible sheet of roofing material (rubber pad) may be required under rooftop support to disperse concentrated loads and add further membrane protection.

D. Utilize properly sized clamps and accessories to suit conduit sizes.

3.5 CONCRETE BASES

A. Provide concrete bases for all floor mounted electrical equipment.

B. Provide concrete bases for all exterior, grade level electrical equipment, and where indicated.

C. Base/Pad Construction:

1. Construct per manufacturer’s recommendations for particular equipment, including suggested piers and dowel rods.

2. Interior concrete bases shall have a minimum depth of 4” unless other indicated or recommended by the manufacturer.

3. Exterior concrete bases shall have a minimum depth of 8” unless other indicated or recommended by the manufacturer.
4. Construct concrete bases for primary and secondary power distribution equipment per requirements of the electrical utility, where submitted for its review.

D. Anchor equipment to base per both supports and equipment manufacturer’s instructions.

E. Coordinate conduit openings and sleeve locations in base with requirements of equipment to be supported.

3.6 BACKBOARDS

A. A minimum of two walls (or as indicated on drawings) shall be covered with plywood backboards to a minimum 8’-6” above finished floor in all Telecommunication Rooms and similar spaces and as indicated on Drawings.

B. Securely fasten backboard to wall using appropriate hardware and mount at all four corners, minimum. Securely fasten backboard to wall-framing members (studs).

C. Provide adequate backboard space to allow a clean and workable arrangement for telephone and data connections.

3.7 PAINTING

A. Touchup: Comply with requirements in Division 09 for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 16073
SECTION 16075 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes the following:
   1. Identification for raceway and metal-clad cable.
   2. Identification for conductors and communication and control cable.
   4. Warning labels and signs.
   5. Equipment identification labels.

1.3 QUALITY ASSURANCE
B. Comply with NFPA 70.

1.4 COORDINATION


B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway and cable size.

B. Color for Printed Legend:
   1. Power Circuits: Black letters on an orange field.
   2. Legend: Indicate system or service and voltage, if applicable.

C. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.2 CONDUCTOR, COMMUNICATION AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.
B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, bright-colored, continuous-printed, polyethylene tape.
   1. Not less than 6 inches wide by 4 mils thick.
   2. Compounded for permanent direct-burial service.
   3. Embedded continuous metallic strip or core.
   4. Printed legend shall indicate type of underground line.

2.4 WARNING LABELS AND SIGNS


B. Self-Adhesive Warning Labels: Factory printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment, unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.5 EQUIPMENT IDENTIFICATION LABELS


B. Outdoor Equipment Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 WIRING DEVICE IDENTIFICATION

A. Description: Self adhesive label with black upper case letters on clear polyester label, font size 7.
3.1 APPLICATION

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service and Feeders More Than 400 A: Identify with orange self-adhesive vinyl label.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:

1. Fire Alarm System: Red.
3. Telecommunication System: Green and yellow.
4. Control Wiring: Green and red.

C. Power-Circuit Conductor Identification: For conductors No. 1/0 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and marker tape. Identify source and circuit number of each set of conductors. For single conductor cables, identify phase in addition to the above.

D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use marker tape. Identify each ungrounded conductor according to source and circuit number as indicated on Drawings. Identify control circuits by control wire number as indicated on shop drawings.

E. Branch-Circuit Conductor Identification: Mark junction box covers in indelible ink with the panel and breaker numbers of other circuits contained within.

F. Conductor Identification: Locate at each conductor at panelboard gutters, pull boxes, outlet and junction boxes, and each load connection or termination point.

G. Emergency Conductors: Color code junction boxes, box covers, and enclosures with red print.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.


I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.

1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
   a. Power transfer switches.
   b. Controls with external control power connections.

2. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

K. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:
a. Indoor Equipment: Engraved, laminated acrylic or melamine label mechanically secured.
b. Outdoor Equipment: Stenciled.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.

2. Equipment to Be Labeled: If included on project. All items may not be on project.
   a. Panelboards, electrical cabinets, and enclosures.
   b. Access doors and panels for concealed electrical items.
   c. Electrical switchgear and switchboards.
   d. Transformers.
   e. Emergency system boxes and enclosures.
   f. Disconnect switches.
   g. Enclosed circuit breakers.
   h. Motor starters.
   i. Push-button stations.
   j. Power transfer equipment.
   k. Contactors.
   l. Remote-controlled switches, dimmer modules, and control devices.
   m. Power-generating units.
   n. Voice and data cable terminal equipment.
   o. Intercommunication and call system master and staff stations.
   p. Television/audio components, racks, and controls.
   q. Fire-alarm control panel and annunciators.
   r. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
   s. Monitoring and control equipment.
   t. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
   u. Breakers or switches at distribution panels.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location:

1. Install identification materials and devices at locations for most convenient viewing without
interference with operation and maintenance of equipment.

2. Conduit Markers: Provide identification for each power conduit containing conductors rated 400A or greater.

C. Apply identification devices to surfaces after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.

1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.

2. Colors for 208/120-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.

3. Colors for 480/277-V Circuits:
   b. Phase B: Orange.
   c. Phase C: Yellow.

4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no
tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

H. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

I. Label information arrangement for 3 lines of text.

1. Line one shall describe the panel or equipment. Line one example: "DP-XX," "RP-XX," "T-XX," "EF-XX," etc.
2. Line two shall describe the first disconnecting means feeding this panel or equipment. Line two example: "Fed from DP-XX," "Fed from RP-XX," etc.
3. Line three indicates that location of the disconnecting means as identified in line two. Line three example: "First Floor Elect. Rm #XXX."
4. Line four shall include "Via T-XX" when panel or equipment is fed from a transformer.

J. Examples:

<table>
<thead>
<tr>
<th>RP-1A</th>
<th>EF-1</th>
<th>LP-1A</th>
</tr>
</thead>
<tbody>
<tr>
<td>FED FROM DP-1A</td>
<td>FED FROM MCC-1A</td>
<td>LOCATED IN</td>
</tr>
<tr>
<td>ELECTRICAL ROOM</td>
<td>MECHANICAL ROOM</td>
<td>ELECTRICAL ROOM A100</td>
</tr>
<tr>
<td>A100</td>
<td>F101</td>
<td></td>
</tr>
<tr>
<td>VIA T-1A</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

K. Fusible Enclosed Switches and Distribution Equipment: Install self-adhesive vinyl label indicating fuse rating and type on the outside of door on each fused switch.

L. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

M. Degrease and clean surface to receive nameplates.

N. Install nameplate and labels parallel to equipment lines.

O. Secure nameplate to equipment front using screws.

P. Secure nameplate to inside surface of door on panelboard that is recessed in finished locations.
Q. Identify conduit using field painting where required.

R. Paint red colored band on each fire alarm conduit and junction box.

S. Paint bands 10 feet on center, and 4 inches minimum in width.

END OF SECTION 16075
SECTION 16120 CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

1.3 SUBMITTALS

1.4 QUALITY ASSURANCE

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

2.2 CONNECTORS AND SPLICES

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

3.3 INSTALLATION OF CONDUCTORS AND CABLES

3.4 CONNECTIONS

3.5 IDENTIFICATION

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

3.7 FIRESTOPPING

3.8 FIELD QUALITY CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Building wires and cables rated 600V and less.
2. Connectors, splices, and terminations rated 600 V and less.

1.3 SUBMITTALS

A. Field Quality-Control Test Reports
1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency as defined by OSHA in 29 CFR 1910.7 or a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for types THHN/THWN-2 and XHHW-2.

C. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for Metal-clad cable, Type MC with ground wire.

D. Power Cable for Variable Frequency Controlled Motors: 600V and 2000V, three conductor, XLPE cable with three symmetrical positioned ground conductors and a continuous impervious corrugated aluminum armor and overall PVC jacket. Cable shield transfer impedance shall be less than 10 ohms per meter up to 30 MHZ when tested in accordance with NEMA WC 61.

1. Approved manufacturers for VFC power cables:
   a. Southwire Armor-x
   b. Draka USA

2.2 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.
PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger, except VFC cable, which shall be extra flexible stranded.

C. Each feeder shall be of the same conductor and insulation material (phase, neutral, and parallel).

D. Use conductor not smaller than 12 AWG for power and lighting circuits. Unless indicated otherwise, all circuits shall be 2#12, 1#12G, ¾”C.

E. Use conductor not smaller than 14 AWG for control circuits, provided by Electrical Contractor.

F. Where equipment is listed for use with copper conductors only, splice from aluminum to copper prior to entering equipment or use copper conductors for the entire length of feeder.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type XHHW-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

E. Exposed Branch Circuits, including in Crawlspaces: Type THHN/THWN-2, single conductors in raceway.

F. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway.
raceway and metal-clad cable, Type MC, for branch circuit drops to devices and within partition walls. MC cable shall not be run in ceiling space in lengths greater than 6'-0".

G. Branch Circuits Concealed in Concrete and below Slabs-on-Grade: Type THHN/THWN-2, single conductors in raceway.

H. Underground Feeders and Branch Circuits: XHHW-2 single conductors in conduit.

I. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel wire-mesh strain relief device at terminations to suit application.


K. Class 1 Control Circuits: Type THHN/THWN-2, in raceway.

L. Class 2 Control Circuits: Power-limited cable, concealed in building finishes.

M. Connection between Variable Frequency Controllers and Motors: Use 600V rated VFC power cable for circuit lengths less than 50 feet and 2000V rated VFC power cable for circuit lengths 50 feet and greater. Support 5’ on center, minimum. Terminate according to cable manufacturer’s recommendations.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.
D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Division 16 Section "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

H. Support communication cables above accessible ceiling, using spring metal clips or plastic cable ties to support cables from structure. Do not rest cable on ceiling panels.

I. Neatly train and lace wiring inside boxes, equipment, and panelboards.

J. Branch circuits may be combined up to 3 circuits in a homerun conduit.

K. Provide a separate neutral conductor for each circuit.

L. Electrical Contractor shall be responsible for de-rating of conductors as required by N.E.C. when more than three current carrying conductors are installed in a single raceway or cable.

M. Type MC cable shall be supported and secured at intervals not exceeding 4'-0".

N. AC/MC cable shall not be used for home runs to receptacle or distribution panels.

O. Where AC/MC cable is stacked in cable tray, or bundled, without spacing, the contractor shall apply the appropriate de-rating factors to the conductors.

P. Where AC/MC cable is permitted by the specifications, MC cable shall not be bundled
Q. Between support, hangers and termination no more than 3" deflection from the bottom of the cable to a horizontal line between the support/hanger or termination.

R. Do not route conductors across roof without prior approval from engineer. Where approved, conductors shall be installed in rigid steel conduit and shall be de-rated for ambient temperature per the NEC.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.
   1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.
   2. Use compression type terminations for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

D. Clean conductor surfaces before installing lugs and connectors.

E. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

F. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and larger.

G. Use piercing connector with insulating covers for conductor splices and taps, 8 AWG and larger only for taps to existing feeders. Do not use piercing connectors in new construction.

H. Use Sta-Kon connectors to terminate stranded conductors #10 AWG and smaller to screw terminals.
I. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260533 "Raceways and Boxes."

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping".

3.8 FIELD QUALITY CONTROL

A. Perform the following field quality control tests in accordance with Division section “Electrical Testing”

1. Description: Test all feeders rated 100 A and above.

2. Visual and Mechanical Inspection

   a. Inspect cables for physical damage and proper connection in accordance with the one line diagram.

   b. Test cable mechanical connections with an infrared survey.

   c. Check cable color-coding against project Specifications and N.E.C. requirements.

3. Electrical Tests

   a. Perform insulation resistance test on each conductor with respect to ground and adjacent
conductors. Applied potential to be 1000 volts dc for 1 minute.

b. Perform continuity test to insure proper cable connection.

4. Test Values

a. Minimum insulation resistance values shall be not less than fifty mega-ohms.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.
B. Related Sections include the following:

1. Division 2 Section, "Underground Ducts and Utility Structures" for exterior duct banks, manholes and underground utility construction.
2. Division 16 Section "Wiring Devices" for devices installed in boxes and for floor-box service fittings, and for access floor boxes and service poles.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.
B. ENT: Electrical nonmetallic tubing.
C. FMC: Flexible metal conduit.
D. IMC: Intermediate metal conduit.
E. LFMC: Liquidtight flexible metal conduit.
F. LFNC: Liquidtight flexible nonmetallic conduit.
G. RNC: Rigid nonmetallic conduit.
H. PVC: Polyvinyl Chloride.
I. HDPE: High Density Polyethylene.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

1.5 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. Comply with NFPA 70.

1.6 COORDINATION

A. Coordinate layout and installation of raceways, boxes, enclosures, cabinets, and suspension system with other construction that penetrates ceilings or is supported by
them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube Triangle Century.
4. Anamet Electrical, Inc.; Anaconda Metal Hose.
5. International Metal Hose.
6. Electri-Flex Co
7. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
8. LTV Steel Tubular Products Company – Manhattan/CDT/Cole-Flex.
11. Wheatland.

B. Rigid Steel Conduit: ANSI C80.1.

C. Aluminum Rigid Conduit: ANSI C80.5.

D. IMC: ANSI C80.6.

E. EMT: ANSI C80.3.

F. FMC: Zinc-coated steel.

G. LFMC: Flexible steel conduit with PVC jacket.

H. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.

2. Fittings for EMT: Steel, set-screw type.
3. Coating for Fittings for PVC-Coated Conduit: Minimum thickness, 0.040 inch, with overlapping sleeves protecting threaded joints.
2.2 FIRE ALARM EMT

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Allied Tube Triangle Century.

B. EMT conduit with bright red topcoat; Fire Alarm EMT.

C. EMT and Fittings: ANSI C80.3.

2.3 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Anamet Electrical, Inc.; Anaconda Metal Hose.
3. Arnco Corp.
4. Cantex Inc.
7. ElecSys, Inc.
8. Electri-Flex Co.
9. Integral.
10. Kor-Kap.
12. Manhattan/CDT/Cole-Flex.
13. RACO; Division of Hubbell, Inc.
15. Spiralduct, Inc./AFC Cable Systems, Inc.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Schedule 40 and Schedule 80 PVC.

D. ENT and RNC Fittings: NEMA TC 3; match to conduit or tubing type and material.

E. LFNC: UL 1660.

2.4 METAL WIREWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hoffman.
2. Square D.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 1.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Screw-cover type.

F. Finish: Manufacturer's standard enamel finish.

2.5 BOXES, ENCLOSURES, AND CABINETS

A. Sheet Metal Outlet and Device Boxes: NEMA OS 1. Shall be used within walls or ceiling.

B. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover. Shall be used in all exposed, non-recessed, locations.

C. Nonmetallic Outlet and Device Boxes: NEMA OS 2. Shall be used in corrosive areas.

D. Floor Boxes: Cast metal, fully adjustable, rectangular.

E. Floor Boxes: Nonmetallic, nonadjustable, round.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover. Shall be used in areas exposed to water.

H. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

I. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. Description: Comply with ANSI/SCTE 77.

1. Color of Frame and Cover: Green.
2. Configuration: Units shall be designed for flush burial and have integral closed bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, as indicated for each system service.
6. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
7. Handholes 12 inches wide by 24 inches long and larger shall have inserts for cable racks and pulling-in irons installed before concrete is poured.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel or fiberglass or a combination of the two.

1. 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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Hubbell: Quazite  
b. Armorcast Products Company.  
c. Carson Industries LLC.  
d. CDR Systems Corporation.  
e. NewBasis.  
f. Christy Concrete Products. 

2.7 SLEEVES FOR RACEWAYS 

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

2.8 SLEEVE SEALS 

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following: 
   1. Advance Products & Systems, Inc.  
   2. Calpico, Inc.  
   3. Metraflex Co.  
   4. Pipeline Seal and Insulator, Inc. 

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.

   1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable. 
   2. Pressure Plates: Plastic. Include two for each sealing element.
   3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.
2.9 **GROUT**

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.10 **SOURCE QUALITY CONTROL FOR UNDERGROUND ENCLOSURES**

A. Handhole and Pull-Box Prototype Test: Test prototypes of handholes and boxes for compliance with SCTE 77. Strength tests shall be for specified tier ratings of products supplied.

1. Strength tests of complete boxes and covers shall be by either an independent testing agency or manufacturer. A qualified registered professional engineer shall certify tests by manufacturer.

2. Testing machine pressure gages shall have current calibration certification complying with ISO 9000 and ISO 10012, and traceable to NIST standards.

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**PART 3 - EXECUTION**

3.1 **RACEWAY APPLICATION**

A. Provide raceways in interior and exterior locations in accordance with the "Raceway Application Matrix" included on the drawings.

B. Boxes and Enclosures, Exterior Aboveground: NEMA 250, Type 3R.

C. Boxes, Enclosures, and Handholes:

1. Handholes and Pull Boxes in Driveway, Parking Lot, and Off-Roadway Locations, Subject to Occasional, Non-deliberate Loading by Heavy Vehicles: Polymer concrete, SCTE 77, Tier 15 structural load rating.

2. Handholes and Pull Boxes in Sidewalk and Similar Applications with a Safety Factor for Non-deliberate Loading by Vehicles: Polymer-concrete units, SCTE 77, Tier 8 structural load rating.

D. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.
E. Minimum Raceway Size: 3/4-inch trade size.

F. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with that material. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer.
3. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

G. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

H. Do not install aluminum conduits in contact with concrete.

I. Install surface raceways only where indicated on Drawings.

J. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.
D. Support raceways as specified in Division 16 Section "Hangers and Supports for Electrical Systems."

E. Install temporary closures to prevent foreign matter from entering raceways.

F. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

G. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

H. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches of changes in direction.

I. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.
   1. Install concealed raceways with a minimum of bends in the shortest practical distance, considering type of building construction and obstructions, unless otherwise indicated.

J. Support conduit within 12 inches of enclosures to which attached.

K. Raceways Embedded in Slabs:
   1. Raceways embedded in slabs shall be limited to above grade concrete decks. Embedded conduit shall be limited to servicing floor boxes and equipment located in open spaces away from accessible walls.
   2. Install in middle 1/3 of slab thickness where practical and leave at least 2 inches (50 mm) of concrete cover.
   3. Secure raceways to reinforcing rods to prevent sagging or shifting during concrete placement.
   4. Space raceways laterally to prevent voids in concrete.
   5. Run conduit larger than 1-inch trade size (DN 27) parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support.
6. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

7. Conduits shall run flat. Do not allow conduits to cross.

8. Change from non-metallic raceway to Rigid Steel before turning up out of the concrete and rising above the floor.

L. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.

1. Run parallel or banked raceways together on common supports.

2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads.
of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

S. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

T. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

U. Telephone and Signal System Raceways, 2-Inch Trade Size and Smaller: In addition to above requirements, install raceways in maximum lengths of 150 feet and with a maximum of two 90-degree bends or equivalent. Separate lengths with pull or junction boxes where necessary to comply with these requirements.

1. Electrical conduit (LB’s) are not permitted.
2. Conduits shall have no more than two 90 degree bends between pull points or pull boxes.
3. Conduits shall contain no continuous sections longer than 100 ft. without a pull point/box.
4. The bend radius of conduit must be at least 6 times the internal diameter for a conduit 2 inches or less and a radius of 10 times the diameter for a conduit greater than two inches.
5. All conduit ends shall have an insulated bushing.

V. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where conduits route through, to, or from a hazardous classified space (Class I or II), provide proper seal offs when exiting or entering the hazardous classified space.
3. Where conduits pass between spaces that are maintained at two different vapor pressures.
4. Where otherwise required by NFPA 70.

W. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment. Install with an adjustable top or coupling threaded inside for plugs set flush with finished floor. Extend conductors to equipment with rigid steel conduit; FMC may be used 6 inches above the floor. Install screwdriver-operated, threaded plugs flush with floor for future equipment connections.

X. Expansion-Joint Fittings:

1. Install in each run of aboveground RNC that is located where environmental temperature change may exceed 30 deg F and that has straight-run length that exceeds 25 feet. Install in each run of aboveground RMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:
   a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F temperature change.
   b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F temperature change.
   c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F temperature change.
   d. Attics: 135 deg F temperature change.
3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.
5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to
manufacturers' written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

Y. Flexible Conduit Connections: Comply with NEMA RV3. Use maximum of 72 inches of flexible conduit for recessed and semirecessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

Z. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals. Provide cover clips to cover space between connecting pieces.

AA. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

BB. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

CC. Locate boxes so that cover or plate will not span different building finishes.

DD. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

EE. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

FF. Set floor boxes level and flush with finished floor surface. Trim non-metallic boxes after installation to fit flush with finished floor surface.

GG. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

HH. Do not route feeders across roof unless approved in writing by Engineer.

II. Provide a pull box (a handhole for outdoor applications) for each conduit run that exceeds 250 feet. Provide two pull boxes (handholes for outdoor applications) for runs that exceed 500 feet.
JJ. Route conduits in finished areas with exposed ceilings at underside of structural deck or as high as possible.

KK. Outlet boxes within hazardous locations shall be of the proper class and division as noted in the N.E.C.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Division 2 Section "Earthwork" for pipe less than 6 inches in nominal diameter.

2. Install backfill as specified in Division 2 Section "Earthwork."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Division 2 Section "Earthwork."

4. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through the floor.

   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete.

   b. For stub-ups at equipment mounted on outdoor concrete bases, extend steel conduit horizontally a minimum of 60 inches from edge of equipment pad or foundation. Install insulated grounding bushings on terminations at equipment.

5. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits, placing them 24 inches o.c. Align planks along the width and along the centerline of conduit.
3.4 INSTALLATION OF UNDERGROUND HANDBOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch sieve to No. 4 sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch above finished grade.

D. Install handholes and boxes with bottom below the frost line, 42" below grade.

E. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables, but short enough to preserve adequate working clearances in the enclosure.

F. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL AND COMMUNICATIONS PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 7 Section "Through-Penetration Firestop Systems."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
D. Rectangular Sleeve Minimum Metal Thickness:

1. For sleeve cross-section rectangle perimeter less than 50 inches and no side greater than 16 inches, thickness shall be 0.052 inch.

2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches above finished floor level.

H. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway unless sleeve seal is to be installed.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry and with approved joint compound for gypsum board assemblies.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 7 Section "Through-Penetration Firestop Systems."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground, exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway material and size. Position raceway in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 7 Section "Through-Penetration Firestop Systems."

3.8 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

3.9 CLEANING

A. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION 16130
SECTION 16139 - CABLE TRAYS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes aluminum cable trays and accessories for telecommunications cable.

B. Related Sections include the following:

1. Division 7 Section under “Through Penetration Firestop Materials” for firestopping materials and installation at penetrations through walls, ceilings, and other fire-rated elements.
2. Division 16 Section “Communications Equipment Room Fittings.”
1.3 SUBMITTALS

A. Product Data: Include data indicating dimensions and finishes for each type of cable tray indicated.

B. Shop Drawings: For each type of cable tray.
   1. Show fabrication and installation details of cable tray, including plans, elevations, and sections of components and attachments to other construction elements. Designate components and accessories, including clamps, brackets, hanger rods, splice-plate connectors, expansion-joint assemblies, straight lengths, and fittings.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: A Nationally Recognized Testing Laboratory (NRTL), acceptable to authorities having jurisdiction, with the experience and capability to conduct the testing indicated.

B. Source Limitations: Obtain cable tray components through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA VE 1, "Metal Cable Tray Systems," if cable tray types specified are defined in the standard.

E. Comply with NFPA 70.

1.5 COORDINATION

A. Coordinate layout and installation of cable trays and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.
2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. B-Line Systems, Inc.
2. Chalfant Cable Trays.
4. MPHusky.
5. Wiremold.
6. Thomas & Betts.

2.2 WIRE BASKET SUPPORT SYSTEM

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. B-Line Flex-Tray.
4. Wiremold.
5. Mono-Systems, Inc.

C. Description: Continuous, welded steel wire mesh construction, 2” x 4” longitudinal and lateral spacing orientation respectively, width and load depth as indicated with mounting hardware to secure in place.

D. Material: ASTM A510 high strength steel wires.

E. Finish: Natural electrostatic, powder-coat paint finish for tray and all fittings.

F. Inside Width: 12 inches, as indicated.

G. Inside Depth: 4 inches.

H. Inside Radius Fittings: 24 inches.
I. Provide manufacturer’s standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, inside radius fittings, can grounding straps. All splicing connectors shall be UL listed for bonding or #6 AWG copper bonding conductors shall be installed at all splices of separate cable tray sections.

J. Wall brackets shall be Cablofil CRP Reinforced Bracket, or equivalent, sized as required to bear full width of cable tray.

K. Provide lay-in lugs for grounding and bonding cable tray.

L. Provide cable roller kit, Cablofil FAS Roller, or equivalent, including all mounting hardware.

2.3 SOURCE QUALITY CONTROL

A. Perform design and production tests according to NEMA VE 1.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CABLE TRAY INSTALLATION

A. Remove burrs and sharp edges from cable trays.

B. Fasten cable tray supports securely to building structure as specified in Division 16 Section "Hangers and Supports for Electrical Systems," unless otherwise indicated.

   1. Locate and install supports according to NEMA VE 1.

C. Install expansion connectors where cable tray crosses building expansion joint and in cable tray runs that exceed 90 feet. Space connectors and set gaps according to NEMA VE 1.
D. Make changes in direction and elevation using standard fittings.

E. Make cable tray connections using standard fittings.

F. Locate cable tray above piping unless accessibility to cable tray is required or unless otherwise indicated.

G. Seal penetrations through fire and smoke barriers according to Division 7 Section "Through-Penetration Firestop Systems."

H. Sleeves for Future Cables: Install capped sleeves for future cables through firestop-sealed cable tray penetrations of fire and smoke barriers.

I. Workspace: Install cable trays with sufficient space to permit access for installing cables.

J. Install barriers to separate cables of different systems, such as power, communications, and data processing; or of different insulation levels, such as 600, 5000, and 15000 V.

K. After installation of cable trays is completed, install warning signs in visible locations on or near cable trays.

L. Support trays in accordance with Division 16 Section "Hangers and Supports for Electrical Systems". Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 10 ft maximum, in general, and 6 feet maximum for wall-mounted tray in Telecom spaces.

M. Spacing of supports shall be less than the span length of straight sections in all cases. Refer to NEMA VE2.

N. Support ladder type tray from trapeze hangers unless noted as wall bracket mounted. Do not use center hung supports except for center spline supported cable tray. Use manufacturer standard wall brackets in lieu of field fabricated.

O. Ground and bond cable tray. Provide continuity between tray components. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly. Bond tray to ground minimum every 100' or at each end, and at all
locations required by NEMA VE2 with a minimum #1 AWG copper insulated ground wire.

P. Cable tray shall be installed physically continuous for the complete run as shown on Drawings. Sprinkler piping, metal studs, ductwork, conduit, etc. shall not interfere with the wiring space provided by the cable tray or access to the cable tray.

Q. Coordinate with the installation of ductwork, sprinkler piping, etc. to provide cable tray access of at least 6" above the top of the tray run and at least 12" on each side of the tray.

R. Where cable tray passes through fire rated walls, provide firestop pillows as specified for rating as required. Refer to Architectural Drawings for locations of rated walls.

S. Where cable tray passes through floors or walls requiring smoke tight construction, provide 3M composite sheets and moldable putty to develop a smoke tight installation after all cables have been installed.

T. Support cable tray independently of other systems and do not use cable tray or its supports for supporting other systems.

U. Balance cable load for center spline supported cable tray evenly on each side to prevent twisting of tray.

V. Provide lateral or transverse supports for cable tray to prevent swaying.

3.3 WIRE BASKET SUPPORT SYSTEMS INSTALLATION

A. Install wire basket as indicated; in accordance with recognized industry practices (NEMA VE-2 2000), to ensure that the cable tray equipment complies with requirements of NEC, and applicable portions of NFPA 70B and NECA’s “Standards of Installation” pertaining to general electrical installation practices.

B. Coordinate wire basket with other electrical work as necessary to properly interface installation of wire basket runway with work of other trades.
C. Provide sufficient space encompassing wire basket to permit access for installing and maintaining cables.

3.4 CONNECTIONS

A. Ground cable trays according to manufacturer's written instructions.

B. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified testing agency to perform the following field quality-control testing:

B. Testing: Engage a qualified testing agency to perform the following field quality-control testing:

C. Testing: Perform the following field quality-control testing:

1. After installing wire basket support systems and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform the following electrical test and visual and mechanical inspections:
   a. Visually inspect each cable tray joint and each ground connection for mechanical continuity.
   b. Measure ground resistance of each system of cable tray from the most remote element to the point where connection is made to service disconnect enclosure grounding terminal. Record resistance in ohms.

3.6 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure wire basket support systems is without damage or deterioration at time of Substantial Completion.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by cable tray manufacturer.
2. Repair damage to PVC or paint finishes with matching touchup coating recommended by cable tray manufacturer.

END OF SECTION 16139
SECTION 16140 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Single and duplex receptacles
2. Ground-fault circuit interrupter receptacles
3. Integral surge suppression receptacles
5. Device wall plates.
6. Floor service fittings
7. Poke-through assemblies
1.3 DEFINITIONS

A. EMI: Electromagnetic interference.
B. GFCI: Ground-fault circuit interrupter.
C. PVC: Polyvinyl chloride.
D. RFI: Radio-frequency interference.
E. SPD: Surge protective devices.
F. UTP: Unshielded twisted pair.
G. USB: Universal serial bus.

1.4 REFERENCES

D. NEMA FB 11: Plugs, Receptacles, and Connectors of the Pin and Sleeve Type for Hazardous Locations.
E. NEMA WD 1: General Requirements for Wiring Devices.
F. NEMA WD 6: Wiring Device - Dimensional Requirements.
G. UL 20: General-Use Snap Switches.
H. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.
I. UL 486B: Wire Connectors for Use with Aluminum Conductors.
J. UL 498: Electrical Attachment Plugs and Receptacles.
K. UL 943: Ground Fault Circuit Interrupters.
L. NECA 130-2010: Installing and Maintaining Wiring Devices.
1.5 SUBMITTALS

A. Product Data: Provide manufacturer’s catalog information showing dimensions, colors, and configurations for each type of product indicated.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer. Insofar as they are available, obtain all wiring devices and associated wall plates from a single manufacturer and source.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 RECEPTACLES

A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498. Configuration 5-20R duplex receptacle.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Hubbell: 5352.
b. Arrowhart: 5352.
c. Bryant: 5362.
d. Pass & Seymour/Legrand; wiring Devices Division: 5362, PT5362 (use with PTRA6STRNA prewired pigtail connector).

B. GFCI Receptacles: Straight blade, non-feed-through type, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch- deep outlet box without an adapter.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hubbell Incorporated; Wiring Device-Kellems GF20-LA.
   c. Leviton 7899.
   d. Pass & Seymour/Legrand; Wiring Devices Division 2095, PT2095 (use with PTRA6STRNA prewired pigtail connector).

C. Self-Test GFCI’s: Duplex GFCI Convenience Receptacles, 125 V, 20 A. Comply with NEMA WD1, NEMA WD6 configuration 5-20R, UL 498, Federal Specification W-C-596 and UL 943, Class A, and include indicator light that is lighted when device is tripped. Must have self-test feature and SafeLock protection™: conducts an automatic test every second, ensuring it’s always ready to protect. If the device fails the self-test, the indicator light flashes to signal that the GFCI should be replaced. With SafeLock Protection™, if critical components are damaged and ground fault protection is lost, power to receptacle must be discontinued.

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work, include, but are not limited to the following:
2. Products: Subject to compliance with requirements, provide one of the following:
   a. Pass & Seymour/Legrand; Wiring Devices Division: 2096.

D. Hospital grade, tamper-resistant receptacles: Straight blade, with safety mechanism to energize contacts only when both openings are simultaneously engaged. Comply with NEMA WD1, NEMA WD6, UL 498, and UL544. Provide in all areas where children may be present (i.e., waiting areas, lobbies, exam rooms, etc.).

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hubbell HBL8300-SG.
b. Leviton 8300-SG.
c. ArrowHart Wiring Devices TR8300.
d. Pass & Seymour/Legrand; Wiring Devices Division: TR63H, PTTR63H (use with PTRA6STRNA prewired pigtail connector).

2.2 WALL SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Hubbell Incorporated; Wiring Device-Kellems 1220 Series.
2. ArrowHart Wiring Devices AH1220 Series.
3. Leviton 1220 Series.
4. Bryant 4900 Series.
5. Pass & Seymour/Legrand; Wiring Devices Division PS20AC Series.

B. Device body: Plastic handle.


D. Snap Switches: Heavy Duty specification grade, quiet type; rated 20A., 120-277 V AC.

E. Provide single-pole, two-pole, three-way and four-way switches as indicated.

F. Provide pilot light where indicated.

G. Provide key type where indicated. Furnish four keys to Owner.

H. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
   2. Receptacle: NEMA WD 6, Configuration 5-20R.

2.3 DIMMER SWITCHES

A. General:
1. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
2. Dimmer switches shall provide full-range, variable control of light intensity utilizing a continuous Square Law dimming curve.
3. Provide protected memory during temporary power failures that restores lights to same level of intensity set prior to power interruption.
4. Provide dimmer switches UL listed for the type of load being served (incandescent, fluorescent, magnetic low voltage transformer, electronic low voltage transformer). Universal load-type dimmer switches shall not be acceptable.
5. Provide dimmers that provide no adverse effects on other components of the electrical system being served (low voltage transformers, ballasts, lamps, etc.).

2.4 WALL PLATES

A. Manufacturers:

1. Provide wall plates and corresponding wiring devices from same manufacturer.

B. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces:
   a. 0.035-inch-thick, satin-finished stainless steel
3. Material for Unfinished Spaces:
   a. Galvanized steel
4. Material for Wet Locations: Gasketed Cast aluminum with spring-loaded cover, and listed and labeled for use in "wet locations."
   a. Manufacturers:
      1) Red Dot Model CKSUV, Thomas & Betts.
      2) ArrowHart WIUM-Series.
FLOOR SERVICE FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Hubbell Incorporated; Wiring Device-Kellems.
   2. Wiremold.
   3. Square D.

B. Type: Modular, flush-type, with services indicated suitable for wiring method used.

C. Compartments: Provide barrier separating power from telecommunications cabling. Provide recessed-type floor service fittings with independent compartments and feed through wiring capability.

D. Service Plate: Provide service plate type as indicated. Provide protective ring for flush service plates.

E. Power Receptacle(s): NEMA WD 6, Configuration 5-20R Heavy-duty grade duplex receptacle, gray finish, unless otherwise indicated.

F. Telecommunications Outlet: Blank cover with bushed cable opening.

FINISHES

A. Color:
   1. Wiring Devices Connected to Normal Power System: As selected by Architect, unless otherwise indicated or required by NFPA 70.
   2. Wall Switches: As selected by Architect, unless otherwise indicated.
   3. Dimmer Switches: As selected by Architect, unless otherwise indicated.
3.1 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Prior to installation of devices, verify wall openings are neatly cut and will be completely covered by wall plates, clean debris from outlet boxes and provide extension rings to bring outlet boxes flush with finished surface.

C. Install devices and assemblies level, plumb, and square with building lines.

D. Install wall dimmers to achieve full rating specified and indicated after derating for ganging according to manufacturer’s written instructions.

E. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' written instructions.

F. Arrangement of Devices:
   1. Coordinate locations of outlet boxes provided under Division 16 Section “Raceways and Boxes” to obtain mounting heights indicated on Drawings.
   2. Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top.
   3. Where multiple switches, dimmers, and/or occupancy sensors are adjacent to each other, provide a single cover plate. Custom fabricate, if required, for all combinations. Provide separate boxes or barriers as required for the application.
   4. Install horizontally mounted receptacles with grounding pole on the left.
   5. Install GFCI receptacles so that the “Push To Test” and “Reset” designations can be read correctly. If printed in both directions, install with ground pole on top.
   6. Install switches with OFF position down.

G. Install cover plates on switch, receptacle, and blank outlets in finished areas.
H. Use oversized plates for outlets installed in masonry walls.

I. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

J. Remove wall plates and protect devices and assemblies during painting.

K. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

L. Adjust devices and wall plates to be flush and level. Three corners of wall plates must be in contact with wall surfaces. Devices shall be solidly mounted against the box.

3.2 IDENTIFICATION

A. Comply with Division 16 Section "Electrical Identification."

1. Receptacles: Identify panelboard and circuit number from which served. Use adhesive label as specified in Division 16 Section “Electrical Identification” with black-filled lettering on back side of wall plate, and durable wire markers or tags inside outlet boxes.

3.3 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding." Connect wiring device grounding terminal to outlet box with bonding jumper. Use of quick ground strap or screw is not acceptable.

B. Connect wiring according to Division 16 Section "Conductors and Cables." Connect wiring devices by wrapping conductor around screw terminal or by using back wiring and tightening the screw securely.

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.
3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Inspect each wiring device for defects.
2. Operate each wall switch with circuit energized and verify proper operation.
3. After installing wiring devices and after electrical circuitry has been energized, test each receptacle for proper polarity, ground continuity, and compliance with requirements.
4. Test each GFCI receptacle for proper operation with both local and remote fault simulations according to manufacturer's written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION 16140
SECTION 16145 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following lighting control devices:

1. Outdoor photoelectric control.
2. Occupancy sensors.

B. Related Sections include the following:

1. Division 16 Section “Electrical General Requirements”.

1.3 REFERENCES

1.4 DEFINITIONS

1.5 SUBMITTALS

1.6 QUALITY ASSURANCE

1.7 COORDINATION

1.8 DELIVERY, STORAGE, AND HANDLING

PART 2 - PRODUCTS

2.1 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

2.2 OUTDOOR PHOTOELECTRIC CONTROL

2.3 OCCUPANCY SENSORS

2.4 LIGHTING CONTACTORS

PART 3 - EXECUTION

3.1 OUTDOOR PHOTOELECTRIC CONTROL INSTALLATION

3.2 OCCUPANCY SENSOR INSTALLATION

3.3 WIRING INSTALLATION

3.4 IDENTIFICATION

3.5 FIELD QUALITY CONTROL

3.6 ADJUSTING
2. Division 16 Section "Wiring Devices" for wall-box dimmers and manual light switches.

1.3 REFERENCES


E. UL 486A: Wire Connectors and Soldering Lugs for Use with Copper Conductors.

F. UL 486B: Wire Connectors for Use with Aluminum Conductors.

G. UL 773A: Nonindustrial Photoelectric Switches for Lighting Control.

H. UL 1449: Transient Voltage Surge Suppressors.

I. UL 1598: Luminaires.

J. NECA 130-2010: Installing and Maintaining Wiring Devices.

1.4 DEFINITIONS

A. LED: Light-emitting diode.

B. PIR: Passive infrared.

C. ULTRASONIC: Active emission of at least 35 kHz sound waves, using Doppler reflectance to detect motion.

D. MICROPHONIC: Passive reception to listen for continued occupancy, with circuitry to filter out white noise.

E. MULTI-Tech: Using PIR and ultrasonic or microphonic technologies in one sensor.
1.5 SUBMITTALS

A. Product Data: For each type of product indicated including physical data and electrical performance.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.
   1. Lighting plan showing location, orientation, and coverage area of each sensor.
   2. Interconnection diagrams showing field-installed wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. Include the following:
   1. Description of operation and servicing procedures.
   2. List of major components.
   3. Recommended spare parts.
   4. Programming instructions and system operation procedures.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.7 COORDINATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

B. Coordinate interface of lighting control devices with temperature controls specified in Division 15.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to the site under provisions of Division 16 Section “Electrical General Requirements”.
B. Store and protect products under provisions of Division 16 Section "Electrical General Requirements".

PART 2 - PRODUCTS

2.1 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.

2.2 OUTDOOR PHOTOELECTRIC CONTROL

A. Manufacturers:
   1. Intermatic, Inc.
   2. Square D.
   3. TORK.

B. General:
   1. Provide fully-gasketed, weathertight enclosure constructed of die cast zinc, with one-half inch conduit nipple for mounting purposes, and with positioning lug to permit full 360-degree adjustable orientation of photocell.
   2. Provide hermetically-sealed, one-inch-diameter, cadmium sulphide photoelectric cell with manual, light level selector.
   3. Provide photoelectric control suitable for an operating temperature range of minus 40 degrees F to plus 140 degrees F.

C. Description: Solid state, with SPST dry contacts rated for 2000 W tungsten or 1800 VA ballasted load, to operate connected load, relay, contactor coils, or microprocessor input, and complying with UL 773A.
   1. Light-Level Monitoring Range: Adjustable turn-on range of 1 to 5 fc (11 to 54 lux) and adjustable turn-off range of 3 to 15 fc (32 to 1662 lux), and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
   2. Time Delay: Adjustable delay up to two minutes to prevent false operation.
3. Contacts: Normally closed, fail on.
4. Electrical: Provide photocell with operating voltage rated to switch the load directly unless otherwise indicated.
5. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.
6. Mounting: Twist lock complying with IEEE C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the North sky exposure.
7. Provide hermatically-sealed, one inch diameter, cadmium sulphide photoelectric cell with manual, 2 to 50 footcandle, light level selector.

2.3 OCCUPANCY SENSORS

A. General

1. Coordinate occupancy sensor locations, coverages and required quantities with manufacturer’s recommendations. Coverage areas indicated on the Drawings are for minor motion (6 to 8 inches of hand movement). Provide additional occupancy sensors and control units as required to achieve complete minor motion coverage of the space indicated.
2. Adjust occupancy sensors and test that complete minor motion coverage is obtained in accordance with Part 3. Provide written confirmation of testing to owner, architect and engineer.
3. Provide occupancy sensors with a bypass switch to override the “ON” function in the event of sensor failure.
4. Provide occupancy sensors with an LED indicator indicating when motion is being detected during testing and normal operation of the sensor.
5. Provide occupancy sensors and occupancy sensor control units from single manufacturer.

B. Wall Switch Passive Infrared Occupancy Sensor

1. Manufacturers:
   a. Perfect Sense – PS-PWS
   b. Wattstopper PW-100.
   d. Greengate OSW-P-0451-W.
   e. Sensorswitch WSD.
f. Philips LRS2210.
g. Leviton ODS10-IDW.

2. Description: Wall mounted, 180° coverage, passive infrared sensing occupancy sensor.
   a. Electrical Characteristics: Capable of switching up to 800W fluorescent or incandescent lighting loads at 120V and 1200 watts fluorescent loads at 277V.
   c. Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 30 minutes.

3. Dual Level Switching: Provide occupancy sensor capable of controlling two switch legs independently where dual level switching is indicated.
   a. Manufacturers:
      1) Perfect Sense PWD.
      2) Wattstopper PW-200.
      4) Greengate OSW-P-0451-DMV.
      5) Sensorswitch WSD-2P.
      6) Philips LRS2215.
      7) Leviton ODSOD-IDW.

C. 360° Ceiling Mounted Dual Technology Occupancy Sensor

1. Manufacturers:
   a. Perfect Sense CDS.
   b. Wattstopper DT 300
   d. Greengate OMC-DT-2000-R.
   e. Sensorswitch CM-PDT-R.
   f. Philips LRM2255.
   g. Leviton OSC10-MOW.
2. Description: Ceiling mounted, 360° coverage, multi-tech sensing occupancy sensor.
   a. Housing: White, thermoplastic, tamper resistant ceiling mount.
   b. Functions: Automatic ON must sense motion from both ultrasonic and infrared sensing elements. Either technology shall maintain ON, with adjustable time delays.
   c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.
   d. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.
   e. Manual override function.

D. 110° Wall Mounted Dual Technology Occupancy Sensor

1. Manufacturers:
   a. Perfect Sense DTC.
   b. Wattstopper DT-200
   c. Hubbell Building Automation “LO-DT” Series.
   d. Sensorswitch WV-PDT-R/WV-BR.
   e. Philips LRM2265.
   f. Leviton OSW12-M0W.

2. Description: Wall mounted, 110° coverage, multi-tech occupancy sensor.
   a. Housing: White, thermoplastic, tamper resistant with swivel bracket for wall or ceiling mounting.
   b. Functions: Automatic ON must sense motion from both sensing elements. Either technology shall maintain ON, with adjustable time delays.
   c. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 15 minutes.
   d. Sensor Orientation: Orient sensor in room such that sensor will not detect motion through open door which could cause false activation.
   e. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor
and provides relay contacts to control the lighting load and auxiliary contacts.


E. 360° Ceiling Mounted Ultrasonic Occupancy Sensors

1. Manufacturers:
   a. Perfect Sense WDS.
   b. Wattstopper “WT” Series.
   e. Sensorswitch CM MPT-10.
   f. Philips LRM2255.
   g. Leviton OSC20-U0W.

2. Description: Ceiling mounted, 360° coverage, ultrasonic or microphonics sensing occupancy sensor.
   a. Housing: White, thermoplastic, tamper resistant.
   b. Adjustments: User adjustable sensitivity and time delay. Time delay shall be adjustable from 30 seconds to 15 minutes.
   c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.

F. 360° Ceiling Mounted Passive Infrared Occupancy Sensor.

1. Manufacturers:
   a. Perfect Sense CPS.
   b. Wattstopper CI-200.
   c. Hubbell Building Automation OMNI-IR.
   d. Greengate OMC-P-04500-R.
   e. Sensorswitch CM-9.
   f. Philips LRM2250.
   g. Leviton OSC04-I0W.

2. Description: Ceiling mounted, 360° coverage, infrared sensing occupancy sensor.
   a. Housing: White, thermoplastic, tamper resistant ceiling mount.
b. Adjustments: User adjustable sensitivity adjustment shall be provided for each sensing technology. Time delay shall be adjustable from 30 seconds to 30 minutes.

c. Sensor shall operate on 24V DC power through control unit which supplies DC power to the sensor and provides relay contacts to control the lighting load and auxiliary contacts.


G. Occupancy Sensor Control Units:

1. Description: Transformer and relay combined in single unit to provide 24DC power to sensors and provide 20A contact(s) for control of lighting loads at 120 or 277V. Control unit input power shall be from unswitched leg of lighting circuit it is controlling.

a. Control units shall be provided as required to power ceiling mounted occupancy sensors, control lighting loads and provide a minimum of one auxiliary contact.

b. Occupancy sensor control units shall mount external to 4” sq junction box in the ceiling space. Wiring between control unit and occupancy sensor shall be plenum rated.

c. Locate control unit in accessible location in gyp-board ceilings, adjacent to return air grilles, or provide access panel.

d. Additional auxiliary relay modules shall be provided as required to provide control of all lighting circuits and additional auxiliary contacts as required.

e. It is acceptable to provide controls and auxiliary contacts as required integral to the ceiling sensor, provided all required contacts are provided.

f. Maximum of 3 sensors per power pack. Verify exact quantities required with manufacturer.

2.4 LIGHTING CONTACTORS

A. Manufacturers:

2. Square D Co.
4. Siemens.
5. Square D Co; class 8903.

B. Contactor

1. Electrically-operated mechanically-held contactor, per NEMA ICS2, with 120 volt, 60 hertz coil and 240 volt, 60 hertz, contacts with size and number of poles indicated.
2. Provide contacts to be 100 percent, continuously rated for all types of ballast and tungsten lighting and resistance loads without the need for in-rush current derating.
3. Provide NEMA type 1 enclosure unless otherwise indicated.
4. Provide NEMA type 1 hinged cover cabinet enclosure sized as required for contactors as indicated on drawings. Mount switches and indicating lights required on front of enclosure. Install terminal strips for connection of all external control wiring connections.
5. Provide solderless pressure wire terminals.
6. Provide corrosion-resistant primer treatment with light gray baked acrylic enamel finish.
7. Provide the following control and indicating devices:
   a. Auxiliary contacts: One field convertible.
   b. Auxiliary relay to convert maintained-contact type control circuit to momentary-contact type control circuit necessary for contactor control.
   c. Hand-off-auto selector switch, of the heavy-duty “oil-tight”, maintained-contact type, mounted on the front cover with legend plate.
   d. Green pilot light to indicate “power on” condition. Mount on front cover with legend plate.

PART 3 - EXECUTION

3.1 OUTDOOR PHOTOELECTRIC CONTROL INSTALLATION

A. Mount photocell on roof or parapet to ½” GRS conduit, supported to building structure below. Coordinate roof penetration with roofing contractor.

B. Install photoelectric control oriented in the northeast direction and not within any potential shadows.
C. Adjust photocell sensitivity and delay to meet owner’s requirements. Multiple adjustments may be required, as needed.

3.2 OCCUPANCY SENSOR INSTALLATION

A. Install wall mounted occupancy sensors as noted on plan. Arrange occupancy sensors with adjacent switch devices so that device plates line-up and are equally spaced.

B. Install ceiling mounted sensors at approximate locations as indicated on plan. Sensor manufacturer shall provide quantity of sensors as required to provide complete coverage for rooms.

C. Locate sensors such that motion through open doors will not falsely activate sensors.

D. Do not locate ultrasonic sensors within six feet of supply air diffusers.

E. Locate infrared sensors to avoid obstructions.

F. Provide the services of a manufacturer’s representative for commissioning of occupancy sensor installation. This shall include consultation on layout and location prior to installing sensors, testing of each sensor for compliance with Contract Documents and field adjustment and fine tuning after installation is complete. Provide written confirmation of testing to the Owner, Architect and Engineer.

G. Field adjustments shall take place in the presence of the owner and the engineer. This shall include owner training on adjustment techniques for the occupancy sensors.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Division 16 Section "Conductors and Cables".

B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
C. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

E. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Division 16 Section "Electrical Identification."

B. Label time switches and contactors with a unique designation.

3.5 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test for compliance with requirements.
2. Operational Test: Verify actuation of each sensor and adjust time delays.

B. Remove and replace lighting control devices where test results indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.

END OF SECTION 16145
SECTION 16211 - ELECTRICITY METERING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

1.2 SUMMARY

1.3 SUBMITTALS

1.4 QUALITY ASSURANCE

1.5 PROJECT CONDITIONS

1.6 COORDINATION

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

PART 3 - EXECUTION

3.1 INSTALLATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes equipment for utility company's electricity metering.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes. Describe electrical characteristics, features, and operating sequences, both automatic and manual. Include the following:

1. Electricity-metering equipment.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For electricity-metering equipment to include in emergency, operation, and maintenance manuals.
1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electrical service according to requirements indicated:

1. Notify Construction Manager no fewer than two days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Construction Manager's written permission.

1.6 COORDINATION

A. Electrical Service Connections: Coordinate with utility companies and components they furnish as follows:

1. Comply with requirements of utilities providing electrical power and communication services.
2. Coordinate installation and connection of utilities and services, including provision for electricity-metering components.

PART 2 - PRODUCTS

2.1 EQUIPMENT FOR ELECTRICITY METERING BY UTILITY COMPANY

A. Current-Transformer Cabinets: Comply with requirements of electrical power utility company.

B. Meter Sockets: Comply with requirements of electrical power utility company.
PART 3 – EXECUTION

3.1 INSTALLATION

A. Comply with equipment installation requirements in NECA 1.

B. Install equipment for utility company metering. Install raceways and equipment according to utility company's written requirements. Provide empty conduits for metering leads and extend grounding connections as required by utility company.

END OF SECTION 16211
SECTION 16231 - PACKAGED ENGINE GENERATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to work of this Section.

1.2 SUMMARY

A. This Section includes packaged engine generator sets for emergency power supply with the following features:
1. Gas engine.
2. Unit-mounted control and monitoring.
3. Outdoor enclosure.

B. Related Sections include the following:

1. Division 16 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

B. Steady-State Voltage Modulation: The uniform cyclical variation of voltage within the operational bandwidth, expressed in Hertz or cycles per second.

1.4 SUBMITTALS

A. Product Data: Submit product data under provisions of Section 16010. Include the following:

1. Data on features, components, accessories ratings, and performance.
2. Thermal damage curve for generator.
3. Time-current characteristic curves for generator protective device.
4. Manufacturer’s anchorage and base recommendations.

B. Shop Drawings: Submit shop drawings under provisions of Section 16010. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Submit shop drawings showing plan and elevation views with overall interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams including schematic and interconnection diagrams.
2. Vibration Isolation Base Details: Signed and sealed by a qualified professional engineer. Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include base weights.

3. Internal Wiring Diagrams: For engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, day tank, remote radiator, and remote annunciator.

C. Qualification Data: For Installer.

D. Source quality-control test reports.

1. Certified summary of prototype-unit test report.
2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
6. Certified report of exhaust emissions showing compliance with applicable EPA regulations.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:

1. List of tools and replacement items recommended to be stored at the Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.
2. Include instructions for normal operation, routine maintenance requirements, service manuals for engine and day tank, oil sampling and analysis for engine wear, and emergency maintenance procedures.

G. Warranty: Special warranty specified in this Section.
1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

1. Maintenance Proximity: Not more than four hours' normal travel time from Installer's place of business to Project site.
2. Engineering Responsibility: Preparation of data for vibration isolators and seismic restraints of engine skid mounts, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

E. Product Options: Drawings indicate size, profiles, and dimensional requirements of packaged generator sets and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a
testing agency acceptable to authorities having jurisdiction, and marked for intended use.

G. Comply with NFPA 37.

H. Comply with NFPA 70.

I. UL2200 Listed and labeled

J. Comply with NFPA 110 requirements for Level 1 emergency power supply system.


L. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

1. Provide engines used for standby applications that carry certification of compliance with current EPA emissions requirements or provide engines which comply with EPA emissions requirements and provide the necessary field testing to certify EPA emissions compliance.

2. Provide engines used for prime power applicants which carry certification of compliance with EPA emissions requirements. Engines which are compliant, but require field certification are not acceptable.

M. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 16 “Hangers and Supports for Electrical Systems.”
1.7 WARRANT

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.
2. If the engine-generator is not functional for a period longer than 24 hours during the warranty period, provide a portable generator to serve emergency loads, until the existing, on site, generator is repaired.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: One for every 10 of each type and rating, but not less than one of each.
2. Indicator Lamps: Two for every six of each type used, but not less than two of each.
3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Caterpillar; Engine Div.
2. Kohler Co; Generator Division.
4. MTU/Onsite Energy.

2.2 ENGINE-GENERATOR SET

A. Packaged engine-generator set shall be a coordinated assembly of compatible components.
B. Safety Standard: Comply with ASME B15.1 and UL 2200.

C. Mounting Frame: Adequate strength and rigidity to maintain alignment of mounted components without depending on concrete foundation. Mounting frame shall be free from sharp edges and corners and shall have lifting attachments arranged for lifting with slings without damaging components.

D. Capacities and Characteristics:

1. Power Output Ratings: Nominal ratings as indicated
2. Output Connections: Three-phase, four wire.
3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

E. Generator set performance:

1. Steady-State Voltage Operational Bandwidth: 4 percent of rated output voltage from no load to full load.
2. Steady-State Voltage Modulation Frequency: Less than 1 Hz.
3. Transient Voltage Performance: Not more than 20 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within three seconds.
4. Steady-State Frequency Operational Bandwidth: 0.5 percent of rated frequency from no load to full load.
5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
6. Transient Frequency Performance: Less than 5 percent variation for a 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within five seconds.
7. Output Waveform: At no load, harmonic content measured line to line or line to neutral shall not exceed 5 percent total and 3 percent for single harmonics. The telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, the system shall supply a minimum of 250 percent of rated full-
load current for not less than 10 seconds and then clear the fault automatically, without damage to generator system components.

9. Start Time: Comply with NFPA 110, Type 10, system requirements.

F. Provide guards for all external rotating parts to prevent accidental injury. Guards shall be securely bolted to the generator but removable for maintenance. Guards shall be painted with a rust inhibiting primer and an epoxy based gloss topcoat. Guards shall comply with OSHA requirements.

G. Service Conditions:

1. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
   a. Ambient Temperature: Minus 15 to plus 40 deg C.
   b. Altitude: Rated for altitude at project location.

2.3 ENGINE

A. Fuel: Natural Gas

B. Rated Engine Speed: 1800 rpm.

C. Lubrication System: The following items are mounted on engine or skid:
   1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
   2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
   3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

D. Engine Fuel System:
   1. Natural Gas
      a. Carburetor.
b. Secondary Gas Regulator.
c. Fuel-Shutoff Solenoid Valve.
d. Flexible Fuel Connectors.

e. Coolant Jacket Heater: Thermal circulation type water heater with integral thermostatic control, sized to maintain engine jacket water at 90 degrees F (32 degrees C), and suitable for operation on 120 volts AC.

F. Governor: Adjustable Isochronous with speed sensing.

G. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.

1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.

   a. Rating: 50-psig maximum working pressure with coolant at 180 deg F, and noncollapsible under vacuum.
   b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

H. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.

1. Minimum sound attenuation of 25 dB at 500 Hz.
2. Sound level measured at a distance of 10 feet from exhaust discharge after installation is complete shall be 85 dBA or less.
I. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

J. Starting System: 12-V electric, with negative ground.

1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.

2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.

3. Cranking Cycle: As required by NFPA 110 for system level specified.

4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.

5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.

6. Battery Compartment: Factory fabricated of metal with acid-resistant finish and thermal insulation. Thermostatically controlled heater shall be arranged to maintain battery above 10 deg C regardless of external ambient temperature within range specified in Part 1 "Project Conditions" Article. Include accessories required to support and fasten batteries in place.


8. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:

   a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.

c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.


e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charge malfunction indication at system control and monitoring panel.

f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet.

2.4 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation:

1. When mode-selector switch on the control and monitoring panel is in the automatic position, remote control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set.

2. When mode-selector switch is switched to the on position the generator set starts.

3. When mode-selector switch is switched to the off position it initiates generator set shutdown.

4. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms.

5. Operation of a remote emergency-stop switch also shuts down generator set.

B. Configuration: Operating and safety indications, protective devices, basic system controls, and engine gauges shall be grouped in a common control and monitoring panel mounted on the generator set. Mounting method shall isolate the control panel from generator-set vibration.
C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system.

D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

E. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals. Data system connections to terminals are covered in Division 16 Section "Electrical Power Monitoring and Control."

F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.

G. Remote Alarm Annunciator:
   2. Labeled LED shall identify each alarm event.
   3. Common audible signal shall sound for alarm conditions.
   4. Silencing switch in face of panel shall silence signal without altering visual indication.
   5. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset.
   6. Cabinet and faceplate shall be flush mounted with painted white finish.

H. Remote Emergency-Stop Switch: Flush; wall mounted, unless otherwise indicated; and labeled. Push button shall be protected from accidental operation.

2.5 GENERATOR OVERCURRENT AND FAULT PROTECTION

A. Generator Circuit Breaker: Molded-case, thermal-magnetic type; 100 percent rated; complying with NEMA AB 1 and UL 489.
   1. Tripping Characteristic: Designed specifically for generator protection.
2. Trip Rating: Matched to generator rating.
3. Shunt Trip: Connected to trip breaker when generator set is shut down by other protective devices.
4. Mounting: Mount unit in enclosure to meet ANSI/NEMA 250, Type 1 requirements. Adjacent to or integrated with control and monitoring panel.
   a. Where multiple output circuit breakers are provided, the output circuit breaker and load wiring that serves the emergency branch shall be physically separated from breakers serving standby branches.

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with ANSI/NEMA MG 1

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: ANSI/NEMA MG 1: Class H or Class F.

D. Temperature Rise: 130 degrees C standby.

E. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

F. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

G. Enclosure: ANSI/NEMA MG 1, open drip proof.

H. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
   1. Manual adjustment on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

I. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.
J. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

K. Subtransient Reactance: 12 percent, maximum.

2.7 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 100 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

1. Provide sound attenuating enclosure to meet the sound criteria specified in Part 1, “Quality Assurance”

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.

1. Louvers: Fixed-engine cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.

2.8 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.

2.9 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard enamel over corrosion-resistant pretreatment and compatible standard primer.

2.10 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent
components and equipped with identical or equivalent accessories.


B. Project-Specific Equipment Tests: Before shipment, factory test engine-generator set and other system components and accessories manufactured specifically for this Project. Perform tests at rated load and power factor. Include the following tests:

1. Test components and accessories furnished with installed unit that are not identical to those on tested prototype to demonstrate compatibility and reliability.
2. Full load run.
3. Maximum power.
4. Voltage regulation.
5. Transient and steady-state governing.
7. Safety shutdown.

C. Report factory test results within 10 days of completion of test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. Beginning of installation means Installer accepts existing conditions.
3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with vibration isolation devices on concrete base.
   1. Size concrete base as recommended by generator manufacturer.
   2. The top of the concrete pad shall be a minimum of 4" above finished grade or adjacent finished floor.
   4. Concrete base construction is specified in Division 16 Section "Hangers and Supports for Electrical Systems."

D. Install Schedule 40, black steel piping with welded joints and connect to engine muffler. Install thimble at wall. Piping shall be same diameter as muffler outlet. Flexible connectors and steel piping materials and installation requirements are specified in Division 15 Section "Hydronic Piping."
   1. Install condensate drain piping to muffler drain outlet full size of drain connection with a shutoff valve, stainless-steel flexible connector, and Schedule 40, black steel pipe with welded joints. Flexible connectors and piping materials and installation requirements are specified in Division 15 Section "Hydronic Piping."

E. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

3.3 CONNECTIONS

A. Piping installation requirements are specified in Division 15 Sections. Drawings indicate general arrangement of piping and specialties.
B. Install fuel, cooling-system, and exhaust-system piping adjacent to packaged engine generator to allow service and maintenance.

C. Connect cooling-system water piping to engine-generator set heat exchanger with flexible connectors.

D. Connect engine exhaust pipe to engine with flexible connector.

E. Connect fuel piping to engines with a gate valve and union and flexible connector.

1. Natural- and LP-gas piping, valves, and specialties for gas distribution outside the building are specified in Division 2 Section "Natural Gas Distribution."

2. Natural- and LP-gas piping, valves, and specialties for gas piping inside the building are specified in Division 15 Section "Fuel Gas Piping."

F. Ground equipment according to Division 16 Section "Grounding and Bonding."

G. Connect wiring according to Division 16 Section "Conductors and Cables."

H. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 IDENTIFICATION

A. Identify system components according to Division 15 Section "Mechanical Identification" and Division 16 "Section Electrical Identification."

3.5 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality control tests in accordance with Division 16 Section "Electrical Testing"

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.

C. Perform the following field tests and inspections and prepare test reports:

1. Provide full load test utilizing portable resistor test bank, for four hours minimum. Simulate power failure including operation of transfer switch, automatic starting cycle, and automatic shutdown, and return to normal. Coordinate with Division 16 Section "Transfer Switches"

2. During test, record the following at 20 minute intervals:
   a. Kilowatts.
   b. Amperes.
   c. Voltage.
   d. Coolant temperature.
   e. Room temperature.
   f. Frequency.
   g. Oil pressure.

3. Test alarm and shutdown circuits by simulating conditions.

4. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.15.2.1 and 7.22.1 (except for vibration baseline test). Certify compliance with test parameters.

5. Perform tests recommended by manufacturer.

6. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, the following:

7. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
   a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
c. Verify acceptance of charge for each element of the battery after discharge.
d. Verify that measurements are within manufacturer's specifications.

8. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.

9. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.

10. Exhaust-System Back-Pressure Test: Use a manometer with a scale exceeding 40-inch wg. Connect to exhaust line close to engine exhaust manifold. Verify that back pressure at full-rated load is within manufacturer's written allowable limits for the engine.

11. Exhaust Emissions Test: Comply with applicable government test criteria.

12. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.

13. Harmonic-Content Tests: Measure harmonic content of output voltage under 25 percent and at 100 percent of rated linear load. Verify that harmonic content is within specified limits.

14. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations on the property line, and compare measured levels with required values.

D. Coordinate tests with tests for transfer switches and run them concurrently.

E. Test instruments shall have been calibrated within the last 12 months, traceable to standards of the National Institute for Standards and Technology, and adequate for
making positive observation of test results. Make calibration records available for examination on request.

F. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

G. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

H. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

I. Remove and replace malfunctioning units and retest as specified above.

J. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

K. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label or tag to each tested component indicating satisfactory completion of tests.

L. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each power wiring termination and each bus connection. Remove all access panels so terminations and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan 11 months after date of Substantial Completion.

2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies terminations and connections checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.
3.6 DEMONSTRATION

A. Provide systems demonstration for Owner, Construction Manager and Electrical Engineer.

B. Simulate power outage by interrupting normal source, and demonstrate that system operates to provide emergency power.

C. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Refer to Division 1 Section "Demonstration and Training."

1. Provide a minimum of two 3-hour training sessions for the Owner’s personnel. One session shall be conducted at time of start-up, the other within three months of start-up.

2. Training shall include: Review of maintenance procedures and schedule, trouble shooting procedures, demonstration of all alarm and safety functions with appropriate actions to be taken, and review of regular testing and exercising schedule including inspection and observation procedures.

3. Coordinate with demonstration and training required in Division 16 section "Transfer Switches".

3.7 CLEANING

A. Clean engine and generator surfaces. Replace oil and fuel filters.

END OF SECTION 16231
SECTION 16289 - SURGE PROTECTIVE DEVICES

PART 1 - GENERAL
1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY
A. This Section includes SPDs for low-voltage power, control, and communication equipment.

B. Related Sections include the following:
1. Division 16 Section "Wiring Devices" for devices with integral SPDs.
1.3 REFERENCES


E. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

F. NEMA LS 1: Low Voltage Surge Protection Devices.


J. UL 1283: Electromagnetic Interference Filters.


1.4 DEFINITIONS


B. SVR: Suppressed voltage rating.

C. SPD: Surge Protective Devices.

1.5 SUBMITTALS

A. Product Data: For each type of product indicated.
   1. Include rated capacities, operating weights, dimensions, mounting provisions, operating characteristics, furnished specialties, and accessories.
2. Provide connection details and wiring diagrams indicating how SPD device is integrated within panelboards and switchgear.

B. Product Certificates: For surge protective devices, signed by product manufacturer certifying compliance with the following standards:

1. UL 1283.
2. UL 1449.

C. Field quality-control test reports, including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Failed test results and corrective action taken to achieve requirements.

D. Operation and Maintenance Data: For surge protective devices to include in emergency, operation, and maintenance manuals.

E. Warranties: Special warranties specified in this Section.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain SPD’s and accessories through one source from a single manufacturer. SPD units integral to switchboards, distribution panelboards and branch circuit panelboards shall be warranted and supported by the panelboard manufacturer.

B. Product Options: Electrical performance of SPD is based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Factory Testing: The specified system shall be factory-tested prior to shipment. Testing of each system shall include but not be limited to quality control checks, “Hi-Pot” tests per UL requirements, IEEE C62.41 Category B and
C. Surge tests, UL ground leakage tests and operational and calibration tests.


F. Comply with NEMA LS 1, "Low Voltage Surge Protection Devices." Provide independent test reports demonstrating complete system performance showing compliance.


1.7 PROJECT CONDITIONS

A. Service Conditions: Rate surge protection devices for continuous operation under the following conditions, unless otherwise indicated:

1. Maximum Continuous Operating Voltage: Not less than 115 percent of nominal system operating voltage.
2. Operating Frequency: 47 to 63 Hz.
3. Operating Temperature: -40 to 140 deg F.
4. Humidity: 0 to 95 percent, noncondensing.
5. Altitude: Less than 20,000 feet above sea level.

1.8 COORDINATION

A. Coordinate location of field-mounted surge suppressors to allow adequate clearances for maintenance.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of surge suppressors that fail in materials or workmanship within five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2. General Electric Company.
3. Siemens Industries, Inc.
4. Square D; Schneider Electric.
5. Current Technology.

2.2 SURGE PROTECTIVE DEVICE

A. Surge Protection Device Description: Sine-wave-tracking type, with the following features and accessories:

1. MOV technology for each suppression mode.
2. Fuses, rated at 200-kA interrupting capacity. Provide fusing for each suppression path.
3. Fabrication using bolted compression lugs for internal wiring. No plug-in component modules, quick disconnect terminals or printed circuit boards shall be used in current-carrying paths.
4. Integral disconnect switch which has been tested to the surge current rating of the SP to match or exceed the fault current rating of the board. Use of circuit breakers for disconnecting means is acceptable.
5. LED indicator lights for power and protection status for each phase mounted in panelboard front cover:
   a. Green indicates fully operational circuit.
   b. Red indicates loss of protection.

6. EMI-RFI Noise Rejection: based on MIL-STD-E220A, 50-ohm standard Insertion Loss Test:
   a. 34dB at 100 kHz.
   b. 51dB at 1 MHz.
   c. 54dB at 10 MHz.
   d. 48dB at 100 MHz.

7. The maximum continuous operating voltage (MCOV) for all voltage configurations shall be 115% if nominal or greater.
8. Audible alarm, with silencing switch, to indicate when protection has failed.
9. One set of dry contacts rated at 5 A and 250-V ac, for remote monitoring of protection status. Coordinate with building power monitoring and control system.

B. Peak Single-Impulse Surge Current Rating for service entrance equipment (B2 Rating): 240 kA per phase; 120 kA
per mode based on a single pulse, IEEE C62.41 standard 8 x 20 microsecond waveform. Device shall not suffer more than 10% deviation in clamping voltage at specified surge current.

C. Minimum Repetitive Surge Current Capability: 10,000 for service entrance and 5,000 for distribution panels and panelboards impulse per mode in accordance with ANSI/IEEE C62.41 and ANSI/IEEE C62.45 utilizing a Category C3 bi-wave at one minute intervals without suffering either performance degradation or more than 10% deviation of specified UL 1449 Suppression Voltage Ratings at specified surge current.

D. Connection Means:

1. Integral: Bus mounted, parallel connection
2. External: Cable connection, parallel wired.

E. Protection modes and UL 1449 Listed and Recognized Component Surge Voltage Rating for grounded wye circuits with voltages of 480Y/277V, 3-phase, 4-wire circuits shall not exceed the following:

1. Line to Neutral: 1200V.
2. Line to Ground: 1200V
3. Neutral to Ground: 1200V
4. Line to Line: 2000V

F. Protection modes and UL 1449 Listed and Recognized Component Surge Voltage Rating for grounded wye circuits with voltages of 208Y/120V, 3-phase, 4-wire circuits shall not exceed the following:

1. Line to Neutral: 700V.
2. Line to Ground: 700V
3. Neutral to Ground: 700V
4. Line to Line: 1500V

G. Protection modes and UL 1449 Listed and Recognized Component Surge Voltage Rating for 240/120V, single phase, 3-wire circuits shall not exceed the following:

1. Line to Neutral: 700V.
2. Line to Ground: 700V
3. Neutral to Ground: 700V
H. Protection modes and UL 1449 Listed and Recognized Component SVR for 240/120-V, 3-phase, 4-wire circuits with high leg shall not exceed the following:

1. Line to Neutral: 700 V, 1500 V from high leg.
2. Line to Ground: 700 V.
3. Neutral to Ground: 700 V.

I. Protection modes and UL 1449 Listed and Recognized Component SVR for voltages of 480V, 3-phase, 3-wire, delta circuits shall not exceed the following:

1. Line to Line: 2000V
2. Line to Ground: 2000V.

2.3 ENCLOSURES

A. NEMA 250, with type matching the enclosure of panel or device being protected.

PART 3 - EXECUTION

3.1 INSTALLATION OF SURGE PROTECTION DEVICES

A. Surge protective devices shall be factory installed in all new distribution equipment.

B. Install devices at service entrance on load side, with ground lead bonded to service entrance ground.

3.2 PLACING SYSTEM INTO SERVICE

A. Do not energize or connect distribution equipment to their sources until surge protection devices are installed and connected.

3.3 FIELD QUALITY CONTROL

A. Testing: Perform the following field tests and inspections and prepare test reports. Test all service entrance and electronic grade panelboard suppressors.

1. After installing surge protection devices, but before electrical circuitry has been energized, test for compliance with requirements.
2. Complete startup checks according to manufacturer's written instructions.
3. Perform each visual and mechanical inspection and electrical test stated in NETA ATS, "Surge Arresters, Low-Voltage Surge Protection Devices" Section. Certify compliance with test parameters.

a. Visual and Mechanical Inspection

1) Inspect for physical damage and compare nameplate data with Drawings and Specifications.
2) Inspect for proper mounting and adequate clearances.
3) Check ground lead on each device for individual attachment to ground bus or ground electrode.

B. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain surge protection devices. Refer to Division 1.

END OF SECTION 16289
SECTION 16410 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. Related Sections include the following:

1. Division 16 Section “Fuses”.

1.2 SUMMARY
A. This Section includes the following individually mounted, enclosed switches and circuit breakers:

1. Fusible switches.
2. Nonfusible switches.
4. Enclosures.

1.3 DEFINITIONS

A. GD: General duty.

B. GFCI: Ground-fault circuit interrupter.

C. HD: Heavy duty.

D. RMS: Root mean square.

E. SPDT: Single pole, double throw.

1.4 REFERENCES


C. NEMA 250: Enclosures for Electrical Equipment (1000 Volts Maximum).

D. NEMA AB 1: Molded Case Circuit Breakers and Molded Case Switches.

E. NEMA FU 1: Low Voltage Cartridge Fuses.

F. NEMA KS 1: Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

G. NEMA PB1.1: General Instructions for Proper Installation, Operation, and Maintenance of Panelboards Rated 600 Volts or Less.

H. NEMA PB2.1: General Instructions for Proper Installation, Operation, and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.

1.5 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports including the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

D. Manufacturer's field service report.

E. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:
   1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   2. Time-current curves, including selectable ranges for each type of circuit breaker.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with NFPA 70.

D. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F and not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

1.8 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spares: For the following:
a. Potential Transformer Fuses: 2 of each size and type.

b. Control-Power Fuses: 2 of each size and type.

c. Fuses for Fusible Switches: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.

2. Spare Indicating Lights: Six of each type installed.

PART 2 - PRODUCTS

2.1 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Industries, Inc.
4. Square D/Group Schneider.

B. Fusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, with clips or bolt pads to accommodate specified fuses, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch: NEMA KS 1, quick make, quick-break load interrupter enclosed knife switch Type HD, externally operable lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Provide early break auxiliary contacts in motor disconnect switches for motors that are fed from variable frequency controllers.
2. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
3. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
4. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.
2.2 TOGGLE DISCONNECT SWITCH

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Double Pole:
   a. Hubbell 1372.
   b. Leviton 6808G-DAC.
   c. Pass & Seymour 7812.
   d. Bryant 30102.

2. Three Pole:
   a. Hubbell 1379.
   b. Leviton 7810GD.
   c. Pass & Seymour 7813.
   d. Bryant 30103.

B. Description: Heavy duty, 30A, 600 volt, double or three pole as required, single throw, motor rated switch without overload protection. Provide NEMA 1 enclosure and padlock attachment.

2.3 MOLDED-CASE CIRCUIT BREAKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
3. Siemens Industries, Inc.
4. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

2. GFCI Circuit Breakers: Single- and two-pole configurations with 5 or 30-mA trip sensitivity as required.
C. Molded-Case Circuit-Breaker Features and Accessories:
Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
2. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Enclosure: Provide handle capable of being locked in the open position with padlock.
5. Communication Capability: Circuit-breaker-mounted communication module with functions and features compatible with power monitoring and control system specified in Division 16 Section "Electrical Power Monitoring and Control."
6. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
7. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
8. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

E. Molded-Case Switch Accessories:

1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.
3. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage. Provide "dummy" trip unit where required for proper operation.
4. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-
second time delay. Provide "dummy" trip unit where required for proper operation.

5. Key Interlock Kit: Externally mounted to prohibit operation; key shall be removable only when switch is in off position.

6. Circuit breaker selection for primary

F. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.

1. Indoor Dry Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
4. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 16 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 3.
3.3 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.

C. Comply with mounting and anchoring requirements specified in Division 16 Section "Vibration and Seismic Controls for Electrical Systems."

D. Install switches with off position down.

E. Install NEMA KS 1 enclosed switch where indicated for motor loads ½ HP and larger and equipment loads greater than 30A.

F. Install toggle disconnect switch, surface mounted, where indicated for motor loads less than ½ HP and equipment loads 30A. and less.

G. Install fuses in fusible disconnect switches.

H. Install flexible liquid tight conduit from toggle disconnect switch to portable equipment. Leave a 6'-0" whip.

I. Install flexible liquid tight conduit from toggle disconnect switch to stationary equipment.

J. Install control wiring from early break contacts in motor disconnect switch to variable frequency controllers to shut down controller when switch is open.

K. Install equipment on exterior foundation walls at least one inch from wall to permit vertical flow of air behind breaker and switch enclosures.

L. Support enclosures independent of connecting conduit or raceway system.
M. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.4 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 16 Section "Electrical Identification."

C. Provide adhesive label as specified in Division 16 Section "Electrical Identification" on inside door of each switch indicating UL fuse class and size for replacement.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.

B. Perform the following field tests and inspections and prepare test reports:

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches. Certify compliance with test parameters.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.6 for molded-case circuit breakers. Test all NEMA AB1, molded case circuit breakers with thermal magnetic trip or auxiliary, solid-state trip units 100A and larger. Certify compliance with test parameters.

   a. Visual and Mechanical Inspection

      1) Circuit breaker shall be checked for proper mounting and compare nameplate data to Drawings and Specifications.
      2) Operate circuit breaker to ensure smooth operation.
3) Inspect case for cracks or other defects.
4) Check internals on unsealed units.

b. Electrical Tests

1) Perform a contact resistance test.
2) Perform an insulation resistance test at 1000 volts dc from pole-to-pole and from each pole-to-ground with breaker closed and across open contacts of each phase.
3) Perform long time delay time-current characteristic tests by passing three hundred percent (300%) rated current through each pole separately. Record trip time. Make external adjustments as required to meet time current curves.
4) Determine short time pickup and delay by primary current injection.
5) Determine ground fault pickup and time delay by primary current injection.
6) Determine instantaneous pickup current by primary injection using run-up or pulse method.
7) Perform adjustments for final settings in accordance with coordination study.
8) For circuit breakers 800A and larger, verify all functions of trip unit by means of secondary injection in lieu of primary injection.

c. Test Values

1) Compare contact resistance or millivolt drop values to adjacent poles and similar breakers. Investigate deviations of more than fifty percent (50%). Investigate any value exceeding manufacturer's recommendations.
2) Insulation resistance shall not be less than 100 megohms.
3) Trip characteristic of breakers shall fall within manufacturer's published time-current characteristic tolerance band, including adjustment factors.
4) All trip times shall fall within N.E.T.A. Acceptance Testing Specifications, Table 10.7 Circuit breakers exceeding specified trip time
at three hundred percent (300%) of pickup shall be tagged defective.

5) Instantaneous pickup values shall be within values shown on N.E.T.A. Acceptance Testing Specifications, Table 10.8 or manufacturer’s recommendations.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip and time delay settings to values as determined by the protective device coordination study.

3.7 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION 16410
SECTION 16415 - TRANSFER SWITCHES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
1.2 SUMMARY
1.3 SUBMITTALS
1.4 QUALITY ASSURANCE
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2.1 MANUFACTURERS
2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS
2.3 AUTOMATIC TRANSFER SWITCH
2.4 SOURCE QUALITY CONTROL

PART 3 - EXECUTION

3.1 INSTALLATION
3.2 WIRING TO REMOTE COMPONENTS
3.3 CONNECTIONS
3.4 FIELD QUALITY CONTROL
3.5 DEMONSTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2 SUMMARY

A. This Section includes transfer switches rated 600 V and less, including the following:

1. Automatic transfer switches.
2. Remote annunciation system.

1.3 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, sections, and elevations showing minimum clearances, conductor entry provisions,
gutter space, installed features and devices, and material lists for each switch specified.

C. Field quality-control test reports.

D. Operation and Maintenance Data: Submit under provision of Section “Electrical General Requirements”. For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 include the following:

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.
3. Include instructions for operating equipment under emergency conditions.
4. Document ratings of equipment and each major component.
5. Include routine preventive maintenance and lubrication schedule.
6. List special tools, maintenance materials, and replacement parts

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Testing Agency Qualifications: Refer to specification section “Electrical Testing”.

C. Source Limitations: Obtain automatic transfer switches, bypass/isolation switches, non-automatic transfer switches, remote annunciators, and remote annunciator and control panels through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, for emergency service under UL 1008, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
E. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

F. UL 1008 - Standard for Automatic Transfer Switches, unless requirements of those specifications are stricter.

G. NFPA 70 - National Electrical Code, including use in emergency and standby systems in accordance with Articles 517, 700, 701 and 702

H. NFPA 110 - Standard for Emergency and Standby Power Systems


K. NEMA Standard ICS2-447 - AC Automatic Transfer Switches

L. IEC - Standard for Automatic Transfer Switches

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of the transfer switch and associated auxiliary components that fail in materials or workmanship within specified warranty period.

   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Contactor Transfer Switches:

       a. Emerson; ASCO Power Technologies, LP
b. Caterpillar; Engine Div.
c. Generac Power Systems, Inc.
d. GE Zenith Controls.
e. Kohler Co.; Generator Division.

2.2 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Provide fault-current and withstand ratings in accordance with UL 1008 standard’s 1½ and 3 cycle long-time ratings. Transfer switches which are not tested and labeled with 1½ and 3 cycle (any breaker) ratings and have series, or specific breaker ratings only, are not acceptable.

C. Annunciation, Control, and Programming Interface Components: Devices at transfer switches for communicating with remote programming devices, annunciators, or annunciator and control panels have communication capability matched with remote device.

D. Solid-State Controls: Repetitive accuracy of all settings is plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

E. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

F. Electrical Operation: Accomplish by a non-fused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.
G. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

H. Neutral Terminal: Solid and fully rated, unless otherwise indicated.

I. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color code or by numbered or lettered wire and cable tape markers at terminations.

1. Designated Terminals: Pressure type suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

J. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCH

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.


D. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of
retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

E. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

F. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

G. Automatic Transfer-Switch Features

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.

2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.

3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.

4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes. Provides automatic defeat of delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.

5. Test Switch: Simulates normal-source failure.

6. Switch-Position Pilot Lights: Indicate source to which load is connected.

a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."

8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.

9. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.

10. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.

2.4 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

B. Identify components according to Division 16 Section "Electrical Identification".

3.2 WIRING TO REMOTE COMPONENTS

A. Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.
3.3 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding."

B. Connect wiring according to Division 16 Section "Conductors and Cables."

C. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Testing: Perform the following field quality control tests in accordance with Division 16 section "Electrical Testing."

1. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.22.3. Certify compliance with test parameters.
   a. Check for electrical continuity of circuits and for short circuits.
   b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
   c. Verify that manual transfer warnings are properly placed.
   d. Perform manual transfer operation.
4. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

   a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
   b. Simulate loss of phase-to-ground voltage for each phase of normal source.
   c. Verify time-delay settings.
   d. Verify pickup and dropout voltages by data readout or inspection of control settings.
   e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
   f. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

C. Coordinate tests with tests of generator and run them concurrently.

D. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

E. Remove and replace malfunctioning units and retest as specified above.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 1.

   1. Coordinate this training with that for generator equipment.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
1.2 SUMMARY

A. This Section includes ac, enclosed controllers rated 600 V and less, of the following types:
   
   1. Across-the-line, manual and magnetic controllers.
   2. Reduced-voltage controllers.
   3. Multispeed controllers.

B. Related Sections include the following:
   
   1. Division 15 Section "Variable Frequency Controllers" for general-purpose, ac, adjustable-frequency, pulse-width-modulated controllers for use on constant torque loads in ranges up to 200 hp.

1.3 SUBMITTALS

A. Product Data: For each type of enclosed controller. Include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each enclosed controller.
   
   1. Include dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      
      a. Each installed unit's type and details.
      b. Nameplate legends.
      c. Short-circuit current rating of integrated unit.
      d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices in combination controllers.
   
   2. Wiring Diagrams: Power, signal, and control wiring.

C. Qualification Data: For manufacturer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For enclosed controllers to include in emergency, operation, and maintenance
manuals. In addition to items specified in Division 1 include the following:

1. Routine maintenance requirements for enclosed controllers and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.

F. Load-Current and Overload-Relay Heater List: Compile after motors have been installed and arrange to demonstrate that selection of heaters suits actual motor nameplate full-load currents.

1.4 REFERENCES

A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
B. ANSI/UL 198C - High-Intensity Capacity Fuses; Current-Limiting Types.
C. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service.
D. FS W-F-870 - Fuseholders (For Plug and Enclosed Cartridge Fuses).
E. FS W-S-865 - Switch, Box, (Enclosed), Surface-Mounted.
F. NECA 402-2000 - Recommended Practice for Installing and Maintaining Motor Control Centers.
G. NEMA AB 1 - Molded Case Circuit Breakers.
H. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
I. NEMA KS 1 - Enclosed Switches.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 100 miles of Project site, a service center capable of providing training, parts, and emergency maintenance and repairs.
B. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain enclosed controllers of a single type through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NFPA 70.

F. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed controllers, minimum clearances between enclosed controllers, and for adjacent surfaces and other items. Comply with indicated maximum dimensions and clearances.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prior to beginning work on any system, verify all existing conditions that affect the work and coordinate with all other trade Contractors. Determine that the work can be installed as indicated or immediately report to the Architect/Engineer errors, inconsistencies or ambiguities.

B. Deliver products to site under provisions of Section 16010. Store and protect products under provisions of Section 16010.

C. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
D. Handle in accordance with manufacturer's written instructions. Lift large equipment only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure, and finish.

E. If stored in areas subject to weather, cover enclosed controllers to protect them from weather, dirt, dust, corrosive substances, and physical damage. Remove loose packing and flammable materials from inside controllers; install electric heating of sufficient wattage to prevent condensation.

1.7 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of each contactor and indicate circuits controlled. Submit under provisions of 16010.

1.8 COORDINATION

A. Coordinate layout and installation of enclosed controllers with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3 Section "Cast-in-Place Concrete."

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 7 Section "Roof Accessories."

D. Coordinate features of enclosed controllers and accessory devices with pilot devices and control circuits to which they connect.

E. Coordinate features, accessories, and functions of each enclosed controller with ratings and characteristics of supply circuit, motor, required control sequence, and duty cycle of motor and load.
1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Spare Fuses: Furnish one spare for every five installed, but no fewer than one set of three of each type and rating.
2. Indicating Lights: Two of each type installed.
3. Keys: Furnish 2 of each to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Danfoss Inc.; Danfoss Electronic Drives Div.
5. Rockwell Automation; Allen-Bradley Co.; Industrial Control Group.
6. Siemens/Furnas Controls.
7. Square D.

2.2 ACROSS-THE-LINE ENCLOSED CONTROLLERS

A. Manual Controller: NEMA ICS 2, general purpose, Class A, with "quick-make, quick-break" toggle or pushbutton action, and marked to show whether unit is "OFF," "ON," or "TRIPPED."

1. Overload Relay: Ambient-compensated type with inverse-time-current characteristics and NEMA ICS 2, Class 10 tripping characteristics. Relays shall have heaters and sensors in each phase, matched to nameplate, full-load current of specific motor to which they connect and shall have appropriate adjustment for duty cycle.

B. Magnetic Controller: NEMA ICS 2, Class A, full voltage, nonreversing, across the line, unless otherwise indicated.
1. Control Circuit: 120 V; obtained from integral control power transformer with sufficient capacity to operate connected pilot, indicating and control devices, plus 100 percent spare capacity.

2. Overload Relay: Ambient-compensated type with inverse-time-current characteristic and NEMA ICS 2, Class 20 tripping characteristic. Provide with heaters or sensors in each phase matched to nameplate full-load current of specific motor to which they connect and with appropriate adjustment for duty cycle.

C. Combination Magnetic Controller: Factory-assembled combination controller and disconnect switch.

1. Fusible Disconnecting Means: 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 947-4-1, as certified by an NRTL.

2.3 REDUCED-VOLTAGE ENCLOSED CONTROLLERS

A. Star-Delta Controller: NEMA ICS 2, closed transition with adjustable time delay.


C. Autotransformer Reduced-Voltage Controller: NEMA ICS 2, closed transition.

D. Solid-State, Reduced-Voltage Controller: NEMA ICS 2, suitable for use with NEMA MG 1, Design B, polyphase, medium induction motors.

1. Adjustable acceleration rate control utilizing voltage or current ramp, and adjustable starting torque control with up to 500 percent current limitation for 20 seconds.

2. Surge suppressor in solid-state power circuits providing 3-phase protection against damage from supply voltage surges 10 percent or more above nominal line voltage.

3. LED indicators showing motor and control status, including the following conditions:
a. Control power available.
b. Controller on.
c. Overload trip.
d. Loss of phase.
e. Shorted silicon-controlled rectifier.

4. Coil operating voltage: 120 volts secondary, 60 hertz.

2.4 MULTISPEED ENCLOSED CONTROLLERS

A. Multispeed Enclosed Controller: Match controller to motor type, application, and number of speeds; include the following accessories:

1. Compelling relay to ensure that motor will start only at low speed.
2. Accelerating relay to ensure properly timed acceleration through speeds lower than that selected.
3. Decelerating relay to ensure automatically timed deceleration through each speed.

2.5 VARIABLE FREQUENCY CONTROLLERS

A. Refer to Division 15 “Variable Frequency Controllers.”

B. Equipment furnished by mechanical trades and installed by electrical trades.

2.6 ENCLOSURES

A. Description: Flush- or surface-mounting cabinets as indicated. NEMA 250, Type 1, unless otherwise indicated to comply with environmental conditions at installed location.

1. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.7 ACCESSORIES

A. Devices shall be factory installed in controller enclosure, unless otherwise indicated.
B. Push-Button Stations, Pilot Lights: NEMA ICS 2, heavy-duty type.

C. Indicating Lights: Run (Red), off or ready (Green).

D. Auxiliary Contacts: Provide two normally open (N.O.) and two normally closed (N.C.) contacts.

E. Selector Switch: NEMA ISC 2, mounted in front cover to read “hand/off/auto,” provide auxiliary contact for auto position monitoring.

F. Control Relays: Auxiliary and adjustable time-delay relays.

2.8 FACTORY FINISHES

A. Finish: Manufacturer's standard paint applied to factory-assembled and -tested enclosed controllers before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and surfaces to receive enclosed controllers for compliance with requirements, installation tolerances, and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Select features of each enclosed controller to coordinate with ratings and characteristics of supply circuit and motor; required control sequence; duty cycle of motor, controller, and load; and configuration of pilot device and control circuit affecting controller functions.

B. Select horsepower rating of controllers to suit motor controlled.

3.3 INSTALLATION

A. For control equipment at walls, bolt units to wall or mount on lightweight structural-steel channels bolted to wall. For controllers not at walls, provide freestanding
racks complying with Division 16 Section "Hangers and Supports for Electrical Systems."

B. Install freestanding equipment on concrete bases.

C. Enclosed Controller Fuses: Install fuses in each fusible switch. Comply with requirements in Division 16 Section "Fuses."

D. Install motor control equipment and contactors in accordance with manufacturer’s instructions.

E. Select and install heater elements in motor starters to match installed motor characteristics.

F. Motor Data: Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.4 CONCRETE BASES

A. Coordinate size and location of concrete bases. Verify structural requirements with structural engineer.

B. Concrete base is specified in Division 16 Section "Hangers and Supports for Electrical Systems," and concrete materials and installation requirements are specified in Division 3.

3.5 IDENTIFICATION

A. Identify enclosed controller, components, and control wiring according to Division 16 Section "Electrical Identification."

3.6 CONTROL WIRING INSTALLATION

A. Install wiring between enclosed controllers according to Division 16 Section "Conductors and Cables."

B. Bundle, train, and support wiring in enclosures.

C. Connect hand-off-automatic switch and other automatic-control devices where applicable.
1. Connect selector switches to bypass only manual- and automatic-control devices that have no safety functions when switch is in hand position.

2. Connect selector switches with enclosed controller circuit in both hand and automatic positions for safety-type control devices such as low- and high-pressure cutouts, high-temperature cutouts, and motor overload protectors.

3.7 CONNECTIONS

A. Conduit installation requirements are specified in other Division 16 Sections. Drawings indicate general arrangement of conduit, fittings, and specialties.

B. Ground equipment according to Division 16 Section "Grounding and Bonding."

3.8 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each enclosed controller element, bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to perform the following:

1. Assist in field testing of equipment including pretesting and adjusting of solid-state controllers.
2. Report results in writing.

C. Testing: Perform the following field quality control tests in accordance with Division 16 section "Electrical Testing"

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.
3.9 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.10 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain enclosed controllers. Refer to Division 1.

END OF SECTION 16420
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes service and distribution switchboards rated 600 V and less.
1.3 DEFINITIONS

A. EMI: Electromagnetic interference.
B. GFCI: Ground-fault circuit interrupter.
C. RFI: Radio-frequency interference.
D. RMS: Root mean square.
E. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of switchboard, overcurrent protective device, transient voltage suppression device, ground-fault protector, accessory, and component indicated. Include dimensions, utility or manufacturer’s anchorage and base recommendations, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Related Submittals:

1. Provide overcurrent device coordination study to demonstrate proper overcurrent device ratings, adjustments, and settings.

C. Shop Drawings: For each switchboard and related equipment.

1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:

   a. Enclosure types and details for types other than NEMA 250, Type 1.
   b. Bus configuration, current, and voltage ratings.
   c. Short-circuit current rating of switchboards and overcurrent protective devices.
   d. Descriptive documentation of optional barriers specified for electrical insulation and isolation if specified.
   e. Utility company's metering provisions with indication of approval by utility company if called out.
f. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring.

D. Field quality-control test reports including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Operation and Maintenance Data: For switchboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:

1. Routine maintenance requirements for switchboards and all installed components.
2. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
3. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain switchboards through one source from a single manufacturer.

C. Product Selection for Restricted Space: Drawings indicate maximum dimensions for switchboards including clearances between switchboards and adjacent surfaces and other items. Comply with indicated maximum dimensions.
D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA PB 2, "Deadfront Distribution Switchboards."

F. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver in sections or lengths that can be moved past obstructions in delivery path.

B. Store indoors in clean dry space with uniform temperature to prevent condensation. Protect from exposure to dirt, fumes, water, corrosive substances, and physical damage.

C. Handle switchboards according to NEMA PB 2.1 and NECA 400.

1.7 PROJECT CONDITIONS

A. Installation Pathway: Remove and replace access fencing, doors, lift-out panels, and structures to provide pathway for moving switchboards into place.

B. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

C. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Construction Manager no fewer than seven days in advance of proposed interruption of electric service.
2. Indicate method of providing temporary electric service.
3. Do not proceed with interruption of electric service without Construction Manager's written permission.
1.8 COORDINATION

A. Coordinate layout and installation of switchboards and components with other construction including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork shall meet load requirements. Requirements for concrete bases for electrical equipment are specified in Division 16 “Hangers and Supports for Electrical Systems.”

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Potential Transformer Fuses: 2 of each size and type.
2. Control-Power Fuses: 2 of each size and type.
3. Fuses for Fused Switches: Equal to 10 percent of amount installed for each size and type, but no fewer than 3 of each size and type.
4. Indicating Lights: 3 of each size and type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2.2 MANUFACTURED UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Eaton Corporation; Cutler-Hammer Products.
3. Siemens Industries, Inc.
4. Square D.

B. Front-Connected, Front-Accessible Switchboard:
   1. Main devices over 1200A: Fixed, individually mounted.
   2. Main devices below 1200A, panel mounted.
   4. Sections rear aligned.

C. Nominal System Voltage: As noted on Drawings.

D. Main-Bus Continuous: As noted on Drawings.

E. Enclosure: Steel, NEMA 250, Type 1 not over 102 in height.

F. Enclosure Finish for Indoor Units: Factory-applied finish in manufacturer's standard gray finish over a rust-inhibiting primer on treated metal surface.

G. Insulation and isolation for main and vertical buses of feeder sections.

H. Bus Transition and Incoming Pull Sections: Matched and aligned with basic switchboard.

I. Hinged Front Panels: Allow access to circuit breaker, metering, accessory, and blank compartments.

J. Buses and Connections: Three phase, four wire, unless otherwise indicated.
      a. If bus is aluminum, use copper- or tin-plated aluminum for circuit-breaker line connections.
      b. If bus is copper, use copper for feeder circuit-breaker line connections.
   2. Ground Bus: 1/4-by-2-inch- minimum-size, hard-drawn copper of 98 percent conductivity, equipped with pressure connectors for feeder and branch-circuit ground conductors. For busway feeders, extend
insulated equipment grounding cable to busway ground connection and support cable at intervals in vertical run.

3. Contact Surfaces of Buses: Silver plated.

4. Main Phase Buses, Neutral Buses, and Equipment Ground Buses: Uniform capacity for entire length of switchboard's main and distribution sections. Provide for future extensions from both ends.


6. Neutral Buses: 100 percent of the ampacity of phase buses, unless otherwise indicated, equipped with pressure connectors for outgoing circuit neutral cables. Bus extensions for busway feeder neutral bus are braced.

K. Future Devices: Equip compartments with mounting brackets, supports, bus connections, and appurtenances at full rating of circuit-breaker compartment.

2.3 SURGE PROTECTIVE DEVICES

A. Direct bus connected type as specified in Division 16 Section "Surge Protective Devices."

B. Provide Surge Protective Device for switchboards that are part of the emergency distribution system.

C. Provide Surge Protective Device for switchboards elsewhere where indicated on the drawings.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting capacity to meet available fault currents.


   a. Circuit Breakers 250A and Larger: Magnetic trip element with front-mounted, field-adjustable trip setting with restricted access cover.

2. GFCI Circuit Breakers: Single- and two-pole configurations with 30-mA trip sensitivity.
B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor material.
2. Application Listing: Appropriate for application; Type HACR for heating, air-conditioning, and refrigerating equipment.

C. Fuses are specified in Division 16 Section "Fuses."

D. Circuit breaker selection for transformer primary protection:

1. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.

E. Circuit breakers rated 1200A and above:

1. Circuit breakers rated 1200A and above, not specified elsewhere with zone selective interlocking, shall be provided with an energy reducing maintenance switch with local status indicator.
2. The switch and status indicators shall be remote from the circuit breaker, located at the entrance to the electrical room where the circuit breaker is installed.

2.5 INSTRUMENTATION

A. Instrument Transformers: NEMA EI 21.1, IEEE C57.13, and the following:

1. Potential Transformers: Secondary voltage rating of 120 V and NEMA accuracy class of 0.3 with burdens of W, X, and Y.
2. Current Transformers: Ratios shall be as indicated with accuracy class and burden suitable for connected relays, meters, and instruments.
3. Control-Power Transformers: Dry type, mounted in separate compartments for units larger than 3 kV.

B. Multifunction Digital-Metering Monitor: Microprocessor-based unit suitable for three- or four-wire systems and with the following features:

1. Switch-selectable digital display of the following values with maximum accuracy tolerances as indicated:

   a. Phase Currents, Each Phase: Plus or minus 1 percent.
   b. Phase-to-Phase Voltages, Three Phase: Plus or minus 1 percent.
   c. Phase-to-Neutral Voltages, Three Phase: Plus or minus 1 percent.
   d. Megawatts: Plus or minus 2 percent.
   e. Megavars: Plus or minus 2 percent.
   f. Power Factor: Plus or minus 2 percent.
   g. Frequency: Plus or minus 0.5 percent.
   h. Megawatt Demand: Plus or minus 2 percent; demand interval programmable from 5 to 60 minutes.
   i. Accumulated Energy, Megawatt Hours: Plus or minus 2 percent. Accumulated values unaffected by power outages up to 72 hours.

2. Mounting: Display and control unit flush or semiflush mounted in instrument compartment door.

2.6 CONTROL POWER

A. Control Circuits: 120 V, supplied through secondary disconnecting devices from control-power transformer.

B. Control-Power Fuses: Primary and secondary fuses for current-limiting and overload protection of transformer and fuses for protection of control circuits.

C. Control Wiring: Factory installed, with bundling, lacing, and protection included. Provide flexible conductors for No. 8 AWG and smaller, for conductors across hinges, and for conductors for interconnections between shipping units.
2.7 ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

B. Furnish portable test set to test functions of solid-state trip devices without removal from switchboard. Include relay and meter test plugs suitable for testing switchboard meters and switchboard class relays.

C. Spare-Fuse Cabinet: Suitably identified, wall-mounted, lockable, compartmented steel box or cabinet. Arrange for wall mounting.

PART 3 - EXECUTION

3.1 PROTECTION

A. Temporary Heating: Apply temporary heat to maintain temperature according to manufacturer's written instructions.

3.2 EXAMINATION

A. Examine elements and surfaces to receive switchboards for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Install switchboards and accessories according to NEMA PB 2.1 and NECA 40.

B. Install switchboards and anchor to concrete bases according to utility or manufacturer’s recommendations, seismic codes at Project, and requirements in Division 16 Section "Hangers and Supports for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from switchboard units and components.
D. Operating Instructions: Frame and mount the printed basic operating instructions for switchboards, including control and key interlocking sequences and emergency procedures. Fabricate frame of finished wood or metal and cover instructions with clear acrylic plastic. Mount on front of switchboards.

E. Install overcurrent protective devices, transient voltage suppression devices, and instrumentation.

1. Set field-adjustable switches and circuit-breaker trip ranges.

3.4 ADJUSTING

A. Adjust circuit breaker trip and time delay settings to values as instructed by the Engineer.

3.5 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."

B. Switchboard Nameplates: Label each switchboard compartment with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.6 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each switchboard bus, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

B. Testing: Perform the following field quality control tests in accordance with Division 16 section “Electrical Testing.”

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Sections 7.1, 7.5, 7.6, 7.9, 7.10, 7.11, and 7.14 as appropriate. Certify compliance with test parameters.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

   a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switchboard. Remove front panels so joints and connections are accessible to portable scanner.
   
   b. Instruments, Equipment, and Reports:

       1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.
       
       2) Prepare a certified report that identifies switchboards included and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.7 CLEANING

A. On completion of installation, inspect interior and exterior of switchboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain switchboards, overcurrent protective devices, instrumentation, and accessories.

END OF SECTION 16441
SECTION 16442 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Distribution panelboards.
2. Lighting and appliance branch-circuit panelboards.

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.
B. GFCI: Ground-fault circuit interrupter.

C. GFEP: Ground-fault equipment protection.

D. AFCI: Arc-fault circuit interrupter.

E. RFI: Radio-frequency interference.

F. RMS: Root mean square.

G. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of panelboard, overcurrent protective device, surge protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Related Submittals:

1. Provide overcurrent device coordination study to demonstrate proper overcurrent device ratings, adjustments, and settings.

C. Shop Drawings: For each panelboard and related equipment.

1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
   a. Enclosure types and details for types other than NEMA 250, Type 1.
   b. Bus configuration, current, and voltage ratings.
   c. Short-circuit current rating of panelboards and overcurrent protective devices.
   d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

2. Wiring Diagrams: Power, signal, and control wiring.

D. Field quality-control test reports including the following:

1. Test procedures used.
2. Test results that comply with requirements.
3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

F. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1, include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.

1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. Source Limitations: Obtain panelboards, overcurrent protective devices, components, and accessories through one source from a single manufacturer.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of panelboards and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with NEMA PB 1.

F. Comply with NFPA 70.
1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:

1. Ambient Temperature: Not exceeding 104 deg F.
2. Altitude: Not exceeding 6600 feet.

B. Service Conditions: NEMA PB 1, usual service conditions, as follows:

1. Ambient temperatures within limits specified.
2. Altitude not exceeding 6600 feet.

1.7 COORDINATION

A. Coordinate layout and installation of panelboards and components with other construction that penetrates walls or is supported by them, including electrical and other types of equipment, raceways, piping, and encumbrances to workspace clearance requirements.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Keys: Six spares for each type of panelboard cabinet lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Panelboards, Overcurrent Protective Devices, Controllers, Contactors, and Accessories:
   a. Eaton Corporation; Cutler-Hammer Products.
c. Siemens Industries, Inc.  
d. Square D.

2.2 MANUFACTURED UNITS

A. Enclosures: Mounting as noted on panel schedules.  
   NEMA PB 1, Type 1.  
   1. Rated for environmental conditions at installed location.  
      a. Outdoor Locations: NEMA 250, Type 3R.  
      b. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.  
      c. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.  
   2. Cabinet Front: Flush or surface cabinet as noted on the Drawings.  
      a. Eaton LTDD (Piano hinge trim)  
      b. GE – FGB (front hinge to box).  
      c. Square D – Continuous piano hinge trim.  
      d. Siemens – Figure 4 hinge to box w/piano hinge.  
   3. Finish: Manufacturer's standard enamel finish over corrosion-resistant treatment or primer coat.  

B. Phase and Ground Buses:  
   2. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors; bonded to box.  
   3. Isolated Equipment Ground Bus: Adequate for branch-circuit equipment ground conductors; insulated from box as called out on panel schedules.  

C. Conductor Connectors: Suitable for use with conductor material.  
   1. Main and Neutral Lugs: Mechanical type.  
   2. Ground Lugs and Bus Configured Terminators: Compression type.
3. Feed-Through Lugs: Mechanical type suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.

4. Double Lugs: Mechanical type mounted at location of main incoming lugs.

D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.

E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.

F. Surge Protective Devices: Where indicated, provide manufactured units with direct bus connected type as specified in Division 16 Section "Surge Protective Devices."

1. Provide Surge Protective Device for all Distribution and Branch Circuit Panelboards that are part of the Emergency Distribution System.
2. Provide Surge Protective Devices elsewhere where indicated on the drawings.

2.3 PANELBOARD SHORT-CIRCUIT RATING

A. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.4 DISTRIBUTION PANELBOARDS

A. Main bus bars, neutral and ground, shall be copper and sized in accordance with U.L. Standards to limit temperature rise on any current carrying part to the maximums as indicated in UL67.

B. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.

C. Main Overcurrent Protective Devices: Circuit breaker.

D. Branch Overcurrent Protective Devices:

1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
2. For Circuit-Breaker Frame Sizes Larger Than 125 A:
   Bolt-on circuit breakers; plug-in circuit breakers
   where individual positive-locking device requires
   mechanical release for removal.
3. Fused switches.

2.5 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Main bus bars, neutral and ground, shall be sized in
   accordance with U.L. Standards to limit temperature rise
   on any current carrying part to the maximums as indicated
   in UL67.

B. Branch Overcurrent Protective Devices: Bolt-on circuit
   breakers, replaceable without disturbing adjacent units.

2.6 OVERCURRENT PROTECTIVE DEVICES

A. Molded-Case Circuit Breaker: NEMA AB 3, with interrupting
   capacity to meet available fault currents.

1. Thermal-Magnetic Circuit Breakers: Inverse time-
   current element for low-level overloads, and
   instantaneous magnetic trip element for short
   circuits.

   a. Circuit Breakers 250A and Larger: Magnetic trip
      element with front-mounted, field-adjustable trip
      setting with restricted access cover.

2. GFCI Circuit Breakers: Single- and double-pole
   configurations with Class A ground-fault protection
   (6-mA trip).

B. Molded-Case Circuit-Breaker Features and Accessories:
   Standard frame sizes, trip ratings, and number of poles.

1. Lugs: Mechanical style, suitable for number, size,
   trip ratings, and conductor materials.
2. Application Listing: Appropriate for application;
   Type SWD for switching fluorescent lighting loads;
   Type HACR for heating, air-conditioning, and
   refrigerating equipment.
3. Do not use tandem circuit breakers.
4. Provide lock on devices for circuit breakers when
   called out on panel schedules with “OD” designation.
5. Provide GFCI circuit breaker when called out on panel schedules with “GFCI” designation.

C. Circuit Breaker Selection for Transformer Primary Protection:

1. Circuit Breaker Selection for Transformer Primary Protection: Provide circuit breakers with time-current characteristics to clear transformer inrush currents while still providing protection for the ANSI through-fault protection curve. Provide circuit breakers with adjustable magnetic trip or electronic trip units as necessary to provide time-current curve shaping to achieve long time trip indicated on drawings, inrush coordination and damage protection.

D. Circuit breakers rated 1200A and above:

1. Circuit breakers rated 1200A and above, not specified elsewhere with zone selective interlocking, shall be provided with an energy reducing maintenance switch with local status indicator.

2. The switch and status indicators shall be remote from the circuit breaker, located at the entrance to the electrical room where the circuit breaker is installed.

2.7 ACCESSORY COMPONENTS AND FEATURES

A. Furnish accessory set including tools and miscellaneous items required for overcurrent protective device test, inspection, maintenance, and operation.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install panelboards and accessories according to NEMA PB 1.1.

B. Comply with mounting and anchoring requirements specified in Division 16 Section “Hangers and Supports for Electrical Systems.”

C. Mount top of trim 74 inches above finished floor, unless otherwise indicated.
D. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.

E. Install overcurrent protective devices and controllers.
   1. Set field-adjustable switches and circuit-breaker trip ranges.

F. Install filler plates in unused spaces.

G. Stub four 1-inch empty conduits from recessed panelboard into accessible ceiling space or space designated to be ceiling space in the future. Stub four 1-inch empty conduits into raised floor space or below slab not on grade.

H. Arrange conductors in gutters into groups and bundle and wrap with wire ties after completing load balancing.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."

B. Create a directory to indicate installed circuit loads after balancing panelboard loads or created by retrofitting. Obtain approval before installing. Use a computer or typewriter to create directory; handwritten directories are not acceptable. Coordinate final directory room names and numbers with Owner.

C. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.3 CONNECTIONS

A. Ground equipment according to Division 16 Section "Grounding and Bonding."

B. Connect wiring according to Division 16 Section "Conductors and Cables."
3.4 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:

1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. Testing: Perform the following field quality control tests in accordance with Division 16 section “Electrical Testing”

1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters. Perform electrical tests on all breakers and switches 200A and above or that constitute a component of an emergency distribution system. Main circuit breakers in branch circuit panelboards 225A and below are not required to be tested.
2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

C. Load Balancing: After Substantial Completion, but not more than 60 days after Final Acceptance, measure load balancing and make circuit changes.

1. Measure as directed during period of normal system loading.
2. Perform load-balancing circuit changes outside normal occupancy/working schedule of the facility and at time directed. Avoid disrupting critical 24-hour services such as fax machines and on-line data processing, computing, transmitting, and receiving equipment.
3. After circuit changes, recheck loads during normal load period. Record all load readings before and after changes and submit test records.
4. Tolerance: Difference exceeding 20 percent between phase loads, within a panelboard, is not acceptable. Rebalance and recheck as necessary to meet this minimum requirement.

D. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an
infrared scanning of each panelboard. Remove panel fronts so joints and connections are accessible to portable scanner.

1. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

2. Record of Infrared Scanning: Prepare a certified report that identifies panelboards checked and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 CLEANING

A. On completion of installation, inspect interior and exterior of panelboards. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION 16442
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Cartridge fuses rated 600 V and less for use in switches and controllers.
2. Spare-fuse cabinets.

1.3 SUBMITTALS

A. Product Data: Include the following for each fuse type indicated:

1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
2. Let-through current curves for fuses with current-limiting characteristics.
3. Time-current curves, coordination charts and tables, and related data.

B. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
   1. In addition to items specified in Division 1 include the following:
      a. Let-through current curves for fuses with current-limiting characteristics.
      b. Time-current curves, coordination charts and tables, and related data.
      c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE
A. Source Limitations: Obtain fuses from a single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Comply with:
   1. NEMA FU 1 - Low Voltage Cartridge Fuses.
   2. NFPA 70 - National Electrical Code.
   3. UL 198C - High-Interrupting-Capacity Fuses, Current-Limiting Types.
   4. UL 198E - Class R Fuses.
   5. UL 512 - Fuseholders.

1.5 PROJECT CONDITIONS
A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F or more than 100 deg F, apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION
A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.
1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Quantity equal to 10% percent of each fuse type and size, but no fewer than three of each type and size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Cooper Bussman, Inc.
3. Ferraz Shawmut, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.

1. Motor Branch Circuits: Class RK5, time delay.
2. Other Branch Circuits: Class RK1, time delay.

2.3 SPARE-FUSE CABINET

A. Cabinet: Wall-mounted, 0.05-inch-thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: 30 inches high by 24 inches wide by 12 inches deep.
2. Finish: Gray, baked enamel.
3. Identification: "SPARE FUSES" in 1-1/2-inch-high letters on exterior of door.
4. Fuse Pullers: For each size of fuse.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Fuses shall be shipped separately. Any fuses shipped installed in equipment, shall be replaced by the Electrical Contractor with new fuses as specified above prior to energization at no additional expense to Owner. All fuses shall be stored in moisture free packaging at job site and shall be installed immediately prior to energization of the circuit in which it is applied.

B. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

C. Install spare-fuse cabinet(s).

3.3 IDENTIFICATION

A. Install labels indicating fuse rating and type on outside of the door on each fused switch.

END OF SECTION 16491
SECTION 16512 - LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1.3 DEFINITIONS

1.4 SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

1.6 MAINTENANCE MATERIAL SUBMITTALS

1.7 QUALITY ASSURANCE

1.8 DELIVERY, STORAGE, AND HANDLING

1.9 COORDINATION

1.10 WARRANTY

PART 2 - PRODUCTS

2.1 LUMINAIRES (LIGHTING FIXTURES)

2.2 LUMINAIRE REQUIREMENTS

2.3 EXIT SIGNS

2.4 EMERGENCY LIGHTING UNITS

2.5 EMERGENCY LOAD TRANSFER DEVICE

2.6 MATERIALS

2.7 METAL FINISHES

2.8 LUMINAIRE FIXTURE SUPPORT COMPONENTS

PART 3 - EXECUTION

3.1 EXAMINATION

3.2 TEMPORARY LIGHTING

3.3 INSTALLATION

3.4 CONNECTIONS

3.5 IDENTIFICATION

3.6 FIELD QUALITY CONTROL

3.7 ADJUSTING

3.8 CLEANING
1. Interior solid-state luminaires that use LED technology.
2. Lighting fixture supports.

B. Related Requirements:

1. Section16145 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multipole lighting relays and contactors.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.
B. CRI: Color Rendering Index.
C. Fixture: See "Luminaire."
D. IP: International Protection or Ingress Protection Rating.
E. Lamp: LED and substrate as a replaceable assembly.
F. LED: Light-emitting diode.
G. Lumen: Measured output of lamp and luminaire, or both.
H. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.4 SUBMITTALS

A. Product Data: For each type of product.

1. Arrange in order of luminaire designation.
2. Include data on features, accessories, and finishes.
3. Include physical description and dimensions of luminaires.
4. Include emergency lighting units, including batteries and chargers.
5. Include life, output (lumens, CCT, and CRI), and energy efficiency data.
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing and Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps and accessories identical to those indicated.
for the lighting fixture as applied in this Project per IES LM-79 and IES LM-80.

a. Manufacturers' Certified Data: Photometric data certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products or certified by a qualified independent testing agency.

B. Shop Drawings: For nonstandard or custom luminaires.

1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each luminaire and for each color and texture with standard factory-applied finish.

D. Samples for Initial Selection: For each type of luminaire with custom factory-applied finishes.

1. Include Samples of luminaires and accessories involving color and finish selection.

E. Samples for Verification: For each type of luminaire.

1. Include Samples of luminaires and accessories to verify finish selection.

F. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:

1. Lighting luminaires.
2. Suspended ceiling components.
3. Partitions and millwork that penetrate the ceiling or extend to within 12 inches of the plane of the luminaires.
4. Structural members to which luminaires will be attached.
5. Initial access modules for acoustical tile, including size and locations.

6. Items penetrating finished ceiling, including the following:
   a. Other luminaires.
   b. Air outlets and inlets.
   c. Speakers.
   d. Sprinklers.
   e. Access panels.
   f. Ceiling-mounted projectors.

7. Moldings.

G. Qualification Data: For testing laboratory providing photometric data for luminaires.

H. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

I. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

J. Product Test Reports: For each luminaire, for tests performed by manufacturer and witnessed by a qualified testing agency.

K. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For luminaires and lighting systems to include in operation and maintenance manuals.

   1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.
1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 5% attic stock of each type and rating installed. Furnish at least one of each type.
2. LED Drivers: 5% attic stock of each type and rating installed. Furnish at least one of each type.
3. Diffusers and Lenses: 1% attic stock of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: 5% attic stock of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Luminaire manufacturer's laboratory that is accredited under the NVLAP for Energy Efficient Lighting Products.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by an independent agency, with the experience and capability to conduct the testing indicated, that is an NRTL as defined by OSHA in 29 CFR 1910.7, accredited under the NVLAP for Energy Efficient Lighting Products, and complying with the applicable IES testing standards.

C. Provide luminaires from a single manufacturer for each luminaire type.

D. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

E. Mockups: For interior lighting luminaires in room or module mockups, complete with power and control connections.

1. Obtain Architect's approval of luminaires in mockups before starting installations.
2. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.

4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

F. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

G. Comply with:

1. NFPA 70 - National Electrical Code.
6. Michigan Department of Community Industry Services requirements that all lamps shall be protected from breakage. Exposed lamps are not acceptable.

H. FMG Compliance: Fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

I. NFPA 101 Compliance: Comply with visibility and luminance requirements for exit signs.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.

1.9 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including
HVAC equipment, fire-suppression system, and partition assemblies.

1.10 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: Five year(s) or manufacturer’s standard warranty length (whichever is longer) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 LUMINAIRES (LIGHTING FIXTURES)

A. Provide Luminaires as included in specification 16512A “Luminaire Product Data.” This section contains product data sheets from the basis of design manufacturer with annotations.

B. Acceptable alternate manufacturers are indicated on the product data sheets. Alternate manufacturer products shall be equal in all respects including materials, finishes, photometric performance and energy performance and shall include all options, features, and accessories identified.

C. The Luminaire schedule shown on the drawings is supplemental provided for convenience and reference only. The requirements of this section and 16512A shall govern.

2.2 LUMINAIRE REQUIREMENTS

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. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.

C. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
D. Unless otherwise specified in Luminaire product data, provide products with a minimum CRI of 80.

E. Unless otherwise specified in Luminaire product data, provide products with a CCT of 3500K.

F. Unless otherwise specified in Luminaire product data, provide products with an IES LM-80 rated lamp life of 50,000 hours.

G. Driver

1. Provided as an integrated component of the luminaire or as an external component of an assembly of luminaries.
2. Nominal Input Voltage: As specified in product data.

2.3 EXIT SIGNS

A. General: Comply with UL 924; for sign colors and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps: Light-emitting diodes, 70,000 hours minimum of rated lamp life.

C. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

1. Battery: Sealed, maintenance-free, nickel-cadmium type with special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.

D. Provide edge lit signs with a mirror plaque background.

2.4 EMERGENCY LIGHTING UNITS

A. General: Self-contained units complying with UL 924.
1. Battery: Sealed, maintenance-free, lead-acid type with minimum 10-year nominal life and special warranty.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Wire Guard: Where indicated, heavy-chrome-plated wire guard protects lamp heads or fixtures.

2.5 EMERGENCY LOAD TRANSFER DEVICE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Bodine GTD Series.
3. Dual Lite.
4. LVS.
5. Side-Lite.

B. Description: Localized load transfer switch to allow emergency fixture to be controlled on normal lighting circuits and to sense presence of normal power ahead of control circuit and switch luminaire (both line and neutral) over to emergency source upon loss of normal source. Device shall be installed integral to luminaire or mounted remotely for each control circuit as application requires.

C. U.L. 924 Listed.

D. Integral test switch and indicating lamps to indicate status.

2.6 MATERIALS

A. Metal Parts:

1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.
B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers and Globes:

1. Acrylic Diffusers: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.
3. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.

D. Factory-Applied Labels: Comply with UL 1598 Locate labels where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp characteristics:
   a. "USE ONLY" and include specific lamp type.
   b. Lamp diameter, shape, size, wattage, and coating.
   c. CCT and CRI for all luminaires.

2.7 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.8 LUMINAIRE FIXTURE SUPPORT COMPONENTS

A. Comply with requirements in Section 16073 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum
1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: Unless otherwise specified in Luminaire product data, provide products with a minimum ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage.

D. Rod Hangers: Unless otherwise specified in Luminaire product data, provide products with a minimum 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for luminaire to verify actual locations of luminaire and electrical connections before fixture installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 TEMPORARY LIGHTING

A. Do not use permanent luminaires for temporary lighting.

3.3 INSTALLATION


B. Locate ceiling luminaires as indicated on reflected ceiling plan.

C. Exit Signs/Lights: Before installation, review and coordinate final locations with Owner’s Representative, Architect, and local Fire Marshall.

D. Support for Fixtures in or on Grid-Type Suspended Ceilings: Use grid for support.
1. Install a minimum of four ceiling support system rods or wires for each fixture. Locate not more than 6 inches from fixture corners.

2. Support Clips: Fasten to fixtures and to ceiling grid members at or near each fixture corner with clips that are UL listed for the application.

3. Fixtures of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support fixtures independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

E. Support luminaires independent of ceiling framing. Support recessed grid luminaries from two opposite corners directly to structure. Wire or rod shall have breaking strength of the weight of fixture at a safety factor of 3.

F. Exposed Grid Ceilings: Fasten surface mounted luminaires to ceiling T using bolts, screws, rivets, or suitable clips.

G. Install recessed luminaires to permit removal from below.

H. Install recessed luminaires using accessories and firestopping materials to meet regulatory requirements for fire rating.

I. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

J. Supports:

1. Sized and rated for luminaire weight.
2. Able to maintain luminaire position after cleaning and relamping.
3. Provide support for luminaire without causing deflection of ceiling or wall.
4. Luminaire mounting devices shall be capable of supporting a horizontal force of 100 percent of luminaire weight and vertical force of 400 percent of luminaire weight.

K. Flush-Mounted Luminaire Support:

1. Secured to outlet box.
2. Attached to ceiling structural members at four points equally spaced around circumference of luminaire.
3. Trim ring flush with finished surface.

L. Wall-Mounted Luminaire Support:

1. Attached using through bolts and backing plates on either side of wall.
2. Do not attach luminaires directly to gypsum board.

M. Ceiling-Mounted Luminaire Support:

1. Ceiling mount with two 5/32-inch-diameter aircraft cable supports 120 inches in length.
2. Ceiling mount with pendant mount with 5/32-inch-diameter aircraft cable supports 120 inches in length.
3. Ceiling mount with hook mount.

N. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches, brace to limit swinging.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

O. Comply with requirements in Section 16120 "Conductors and Cables" for wiring connections.

P. Connect night light fixtures and emergency lighting fixtures to the hot (unswitched) side of lighting circuits.

Q. Provide green grounding conductors back to the panel ground for lighting circuits. Raceways shall not be used as grounding conductors.

R. Fixtures shall have their exterior labels removed and shall be thoroughly cleaned. Non-functioning LED Boards and drivers shall be replaced.
S. For emergency fixtures, locate the remote test/monitor modules identically so that they are visible and they form a straight line when viewed from the end of the corridor or room. Where a suspended ceiling exists, center the modules in adjacent ceiling tiles.

T. Mount LED emergency lighting units where shown and aim to light the egress path as uniformly as possible.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

B. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

C. Bond products and metal accessories to branch circuit equipment grounding conductor.

D. Connect luminaires to branch circuit outlet boxes provided under 16130 Section "Raceways and Boxes" using 1/2" flexible conduit.

3.5 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 16075 "Electrical Identification."

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.

2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.
B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

D. A visual inspection shall be performed to verify cleanliness and alignment of the fixtures, misalignment and light leaks shall be corrected, and rattles due to ventilation system vibration shall be eliminated.

3.7 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting the direction of aim of luminaires to suit occupied conditions. Make up to two visits to Project during other-than-normal hours for this purpose. Some of this work may be required during hours of darkness.

1. During adjustment visits, inspect all luminaires. Replace lamps, drivers, or luminaires that are defective.
2. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
3. Adjust the aim of luminaires in the presence of the Architect.

B. Adjust exit sign directional arrows as indicated on Drawings.

C. Adjust and calibrate all dimming system controls until the system works as designed. Contact the Architect/Engineer when dimming is complete and demonstrate operation to owner’s representative and Architect/Engineer.

3.8 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosures and lenses.

C. Clean photometric control surfaces as recommended by manufacturer.
D. Clean finishes and touch up damage.

END OF SECTION 16512
The 1917 New Jersey series is a dramatic looking downlight fixture which consists of a
cast aluminum fitter, cast ballast housing assembly, a decorative shade and glass
lens. It measures 27" diameter by 22 1/2" tall. Its dome housing shall be made of cast
aluminum and its decorative shade shall be spun aluminum.

Lens: Flat Glass (FG) (FG)

**NUMBER OF ARMS: 1-**

**ARM MOUNTED FIXTURE: 1917**

**POLE: 550P516/**

The 12" diameter cast 356 aluminum alloy base and aluminum shaft shall be a one-piece
construction. For fixtures using remote ballasts or drivers, the servicing of these components
requires pulling the pole. The pole shall be U.L. or E.T.L. listed in U.S. and Canada.

Model: 550
Shaft Type: 5 Inch, 6061-T6 Aluminum Alloy (P5)
Height: 16 Ft (16/)

**LIGHT SOURCE: INCAND120MED/**

B Allast: INCAND
Voltage: 120
Socket Type: Medium Base (MED)

**OPTIONS: EZ/**

Hangstraight: EZ Vertical (EZ)

**FINISH: BK**

Assembly shall be powder coated to Black Smooth finish. Prior to coating, the assembly shall
be chemically cleaned and etched in a 5-stage washing system which includes alkaline
cleaning, rinsing, phosphoric etching, reverse osmosis water rinsing, and non-chrome sealing
to ensure corrosion resistance.

**ACCESS DOOR AND 11" DIA.**

**5"DIA FLUTED POLE .250 WALL THICKNESS 6061-T6 STRUCTURAL GRADE ALUMINUM**

**PROVIDE LED LAMP WITH FIXTURE, SEE ASSOCIATED CATALOG CUT.**

**PROVIDE FLUTED POLE BASE.**

**FIXTURE SHALL HAVE MANUFACTURERS LABEL INDICATING LED REPLACEMENT LAMP TYPE.**

**5'11/16"**

**23'-0"**

**18'-0"**

Bolt Info: (4) 3/4" x 18" Anchor Bolts, 8-5/16" Bolt Circle, Diamond Pattern

Access Door Orientation: 0°

Street Side Orientation: 180°
Product Description

The Maize series is an exceptional product with a track record of 7 years in the field. We use the latest technology and continue to raise the bar in terms of housing quality, lamp efficacy, and overall extended lifespan. Using only top quality components such as Rubycon capacitors, flame retardant materials, a water resistant cover, and LG LEDs, the Maize series is a market leader for commercial applications.

Performance Summary

• LG 5630 SMD LED with high efficacy >130 Lm/W
• National listing lab tested with IES standards
• IP64 rated for indoor or limited outdoor use
• Internal isolated driver for quick and easy installation
• Aviation grade 6063 aluminum heatsink dissipates heat without a fan
• Suitable for totally enclosed fixtures
• Polycarbonate lens cover provides dust and water protection
• Clear lens for maximum lumen output
• Diffused lens reduces glare and enhances appearance
• Rubycon capacitance power and 4KV surge built-in for best protection
• Contains no mercury or lead and cool to the touch
• No infrared or UV radiation
• Generates low heat, reducing your HVAC loads
• Flame retardant housing material
• High CRI - RA>80 enhances original colors
• Beam angle: 360 degrees
• Power factor: >.90
• Operating temperature: -40 to 60 degrees celsius
• 100,000 hour LED life
• Certifications: CE, FCC, RoHS, SAA, cUL, UL, DLC
• 1 year system warranty

Models:

• VVDG2815: 45 LEDS - 15W - 1950 Lm - 6.3” (L) x 2.5” (D) - E26/E39 Base
• VVDG2819: 54 LEDS - 19W - 2470 Lm - 6.7” (L) x 2.5” (D) - E26/E39 Base
• VVDG2824: 72 LEDS - 24W - 3120 Lm - 7.3 (L) x 2.5” (D) - E26/E39 Base
• VVDG2827: 84 LEDS - 27W - 3645 Lm - 8.6’’ (L) x 2.5” (D) - E26/E39/EX39 Base
• VVDG2836: 112 LEDS - 36W - 4860 Lm - 9.6” (L) x 3.4” (D) - E26/E39/EX39 Base
• VVDG2845: 140 LEDS - 45W - 6075 Lm - 10.8” (L) x 3.4” (D) - E26/E39/EX39 Base
• VVDG2854: 168 LEDS - 54W - 7290 Lm - 10.8’’ (L) x 3.4” (D) - E26/E39/EX39 Base
• VVDG3180: 250 LEDS - 80W - 10800 Lm - 11.6” (L) x 5.1” (D) - E39/EX39 Base
• VVDG3110: 288 LEDS - 100W - 13500 Lm - 12.8” (L) x 5.1” (D) - E39/EX39 Base
• VVDG3112: 336 LEDS - 125W - 16875 Lm - 14.1” (L) x 5.1” (D) - E39/EX39 Base

Ordering Information:

- DLC not available for E26 Medium Base. DLC not available for all CCT. Please inquire.
- Ordering Example: VVDG2815-30-T5-UNV-CL-E26

<table>
<thead>
<tr>
<th>Family</th>
<th>Part Number</th>
<th>CCT*</th>
<th>Optic</th>
<th>Voltage</th>
<th>Lens Cover</th>
<th>Base Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>VVDG2815</td>
<td>VVDG2819</td>
<td>30 - 3000K</td>
<td>TS - Type V 360 Degree</td>
<td>UNV - 100-277V</td>
<td>CL - Clear</td>
<td>E26 - Medium*</td>
</tr>
<tr>
<td>VVDG2815</td>
<td>VVDG2824</td>
<td>35 - 3500K</td>
<td>40 - 4000K</td>
<td>45 - 4500K</td>
<td>50 - 5000K</td>
<td>E39 - Mogul</td>
</tr>
<tr>
<td>VVDG2827</td>
<td>VVDG2836</td>
<td>57 - 5700K</td>
<td>24W</td>
<td>3120 Lm</td>
<td>E39/EX39 - Mogul</td>
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</tr>
<tr>
<td>VVDG2845</td>
<td>VVDG3180</td>
<td>7290 Lm</td>
<td>10.8” (L) x 3.4” (D)</td>
<td>E26/E39/EX39 Base</td>
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<tr>
<td>VVDG2854</td>
<td>VVDG3110</td>
<td>13500 Lm</td>
<td>12.8” (L) x 5.1” (D)</td>
<td>E39/EX39 Base</td>
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<tr>
<td>VVDG3112</td>
<td>VVDG3112</td>
<td>16875 Lm</td>
<td>14.1” (L) x 5.1” (D)</td>
<td>E39/EX39 Base</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Cautions:
- Remove ballast before installing
- Check dimensions of lamp for fitment

Listed lengths are calculated for E39 or EX39 base. The E26 base is slightly shorter.
**MIGHTY MAC™**

**RMCA SERIES**

**PRODUCT FEATURES:**
- Recessed ceiling mount – 12” x 24” (30.48cm x 60.96cm), 12” x 48” (30.48cm x 122cm)
- T&G ventilating housing with no post grinding for additional strength
- Vertically adjustable 2 bracket with thru-studs spaced 6” (15.24cm) apart
- Full length concealed internal piano hinge

**SPECIFICATIONS**

- **HOUSING**: Die-formed prime grade material as specified – see ordering information. T&G and spot welded construction.
- **LENS**: As specified – maximum thickness .500” (1.27cm) – see ordering information. Kenall recommends a prismatic inner lens and a clear outer lens. Two clear lenses used in combination cannot be provided.
- **LENS RETENTION**: Vertically adjustable continuous “Z” brackets of prime grade material, secured to housing via thru-studs (6” (15.24cm) maximum spacing).
- **DOOR**: One-piece die-formed prime grade material as specified – see ordering information. Corners continuously seam welded and smooth with no post grinding (T&G).
- **HINGE**: Full length completely concealed internal piano hinge (1/2” (1.27cm) knuckle/1/8” (.32cm) diameter pin) standard. Pin secured to knuckle. Hinge welded to door.
- **LENS RETENTION**: Vertically adjustable continuous “Z” brackets of prime grade material, secured to housing via thru-studs (6” (15.24cm) maximum spacing).
- **类型的**
- **RECOMMENDED CEILING CUTOUT**: 48.250” (122.24cm) minimum.

**LAMPS**

- **LED ELECTRICAL**:
  - Available 3500K, 4000K and 5000K color temperatures, 82 CRI. 120-277VAC, 50/60Hz electrical input with serviceable high power factor electronic, constant-current driver.
  - THGIC polyester powder coat – 5-stage pre-treatment. Salt spray test: 1,000 hours; Reflectance: 92%.
  - One-piece die-formed prime grade material as specified – see ordering information. Corners continuously seam welded and smooth with no post grinding (T&G).
  - Die-formed prime grade material as specified – see ordering information. TIG and spot welded construction.
  - TGIC polyester powder coat – 5-stage pre-treatment. Salt spray test: 1,000 hours; Reflectance: 92%.
  - One-piece die-formed prime grade material as specified – see ordering information. Corners continuously seam welded and smooth with no post grinding (T&G).

**WARRANTY**: Limited five (5) year warranty on LED lamps.

**LISTINGS**: UL and CUL listed for damp locations. See ordering information for wet location applications. Non IC rated.

**PHOTOMETRICS**:

- Limited five (5) year warranty on LED lamps.
- Warranty: 5 years.
- Listings: UL and CUL listed for damp locations. See ordering information for wet location applications. Non IC rated.

**ORDERING INFORMATION**

(Ex: RMCA-2-TG-0/0-2.17-15-1-120-1/B-1)

<table>
<thead>
<tr>
<th>Model</th>
<th>Size</th>
<th>Ceiling Type</th>
<th>Door/Housing Material</th>
<th>Lamp Qty</th>
<th>Lamp Type</th>
<th>Ballast/Driver Type</th>
<th>Ballast Qty</th>
<th>Voltage</th>
<th>Lens (Inner/Outer)</th>
<th>Fasteners</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>RMCA-022817</td>
<td>2’ (60.96cm)</td>
<td>Nominal Length</td>
<td>2’ (60.96cm)</td>
<td>17</td>
<td>F31T8</td>
<td>F40T (2 Lamp Max.)</td>
<td>40B</td>
<td>120 Volts</td>
<td>347 Volts (Consult Factory)</td>
<td>Fastener 1: Torx® Head with Center Pin</td>
<td>2: Allen Head with Center Pin</td>
</tr>
</tbody>
</table>

**Ceiling Type**

- FLTR Flange/Threaded Rod Flange/Cross Channel FL/CC Flange/Yoke FL/YK Swing-Out Arms FL/S/KA Swing-Out Arms FL/SA Flange/Swing-Out Arms FL/YC Flange/Swing-Out Arms FL/YK Flange/Yoke

**Door/Housing Material**

- 16-Ga CRS (Painted White)
- 18-Ga SS (Painted White)
- 18-Ga CRS (Brushed)
- 16-Ga SS (Brushed)
- 16-Ga CRS (Painted White)
- 16-Ga SS (Painted White)
- 16-Ga CRS (Painted White)
- 16-Ga SS (Brushed)
- 16-Ga CRS (Brushed)
- 16-Ga SS (Painted White)
- 16-Ga SS (Brushed)

**Lamp Qty (n/a with LED)**

- 1
- 2
- 3

**Lens (Inner/Outer)**

- 1: No lens
- 2: 125˚ (32mm) Prismatic Acrylic
- 3: 125˚ (32mm) Textured Polycarbonate
- G*: 125˚ (32mm) Clear Polycarbonate

**Ballast/Driver Type**

- 45L50K 45-Watt 5000K LED
- 67L40K 67-Watt 4000K LED
- 67L50K 67-Watt 5000K LED
- 90L30K 90-Watt 3500K LED
- 90L40K 90-Watt 4000K LED
- 90L50K 90-Watt 5000K LED
- 32 F32T8

**Volatage**

- 120 Volt
- 277 Volt
- 347 Volt (Consult Factory)

**Options**

- LEL LED Emergency Battery Backup
- DNL LED Night Light Weight Level Control
- EL Standard Lumen EL Pack
- FS Single Fuse & Holder
- HLH High Lumen EL Pack
- SEL Specified EL Pack
- SC Specified Ceiling
- TN F1 Night Light – 5/7/9 Watt
- UV Ultraviolet Filter
- WL Wet Location Listed

*LEL Options

- LEL Emergency Battery Backup
- DNL LED Night Light Weight Level Control
- EL Standard Lumen EL Pack
- FS Single Fuse & Holder
- HLH High Lumen EL Pack
- SEL Specified EL Pack
- SC Specified Ceiling
- TN F1 Night Light – 5/7/9 Watt
- UV Ultraviolet Filter
- WL Wet Location Listed

**Fasteners**

- 1: Torx® Head with Center Pin
- 2: Allen Head with Center Pin

**Options**

- Fastener 1: Torx® Head with Center Pin
- Fastener 2: Allen Head with Center Pin

**Coordinate Fastener Type with Architect**

**Refer to plans for ceiling type**

**Lighting Fixture Cutsheets**

16512A – 3

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MIGHTY MAC™
RMCA SERIES

PERFORMANCE

<table>
<thead>
<tr>
<th>Lamp Type</th>
<th>@ 25°C</th>
<th>Efficacy (lm/W)</th>
<th>Input Power (W)</th>
<th>Drive Current (mA)</th>
<th>Estd. L70 LED Life (Hrs)</th>
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</thead>
<tbody>
<tr>
<td>45L35K</td>
<td>2747</td>
<td>55</td>
<td>50</td>
<td>94</td>
<td>80,000</td>
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<td>45L40K</td>
<td>2928</td>
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<td>74</td>
<td>66</td>
<td>80,000</td>
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<td>74</td>
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<td>74</td>
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<td>5579</td>
<td>57</td>
<td>98</td>
<td>94</td>
<td>60,000</td>
</tr>
</tbody>
</table>

Displayed information is for selected luminaires only. Additional wattages and color temperatures are also available. Visit www.kenall.com for additional information.

Model: RMCA-4-TG-1/1-45L40K-DCC-DC-Y/B-1

Maximum Candela = 1606 Located At Horizontal Angle = 15, Vertical Angle = 5
1 - Vertical Plane Through Horizontal Angles (15-195) (Through Max. Cd.)
2 - Horizontal Cone Through Vertical Angle (5) (Through Max. Cd.)

Model: RMCA-4-TG-1/1-90L40K-DCC-DC-Y/B-1

Maximum Candela = 2942 Located At Horizontal Angle = 15, Vertical Angle = 5
1 - Vertical Plane Through Horizontal Angles (15-195) (Through Max. Cd.)
2 - Horizontal Cone Through Vertical Angle (5) (Through Max. Cd.)

DIMENSIONAL DATA

CROSS SECTION

MOUNTING HOLES

RECOMMENDED CEILING CUTOUT: 24.250" x 10.437" (61.60cm x 26.51cm)

RECOMMENDED CEILING CUTOUT: 48.250" x 10.437" (123cm x 26.51cm)
**Luna® 2x2 LED**

**DIMENSIONAL DATA**

Overall height for ST luminaire is 5.5".

**FEATURES**

Architectural recessed LED luminaire with perforated center basket.

Classic style updated with the latest technology.

Reflector and end caps form seamless one-piece housing.

High reflectance, low gloss Matte White finish controls glare.

Comparable output to fluorescent versions with reduced wattage.

Luna® LED provides high angle uniform distribution ideal for comfortable general illumination.

**PERFORMANCE**

**PRODUCT OVERVIEW**

- Lumen Output: 2000-3500lm
- Wattage: 23-47W
- LPW: 74-87
- SDCM: 3
- Lumen: L90 @ Maintenance: 98,000hrs

Delivered Lumens: 2500lm

Total System Watts: 31W

Photometric performance is measured in accordance with IESNA LM-79. Visit focalpointlights.com for complete photometric data.
Focal Point LLC reserves the right to change specifications for product improvement without notification.

**Fixture:**

- 22
- PS
- FLUL
- 2000L
- 2500L
- 3000L
- 3500L
- 3000K
- 35K
- 4000K
- 40K
- 1C
- 120 Volt
- 277 Volt
- UNV Volt
- LD1
- L3D
- C24
- C48
- C96
- F
- G
- ST
- SM
- AR
- CP
- B310
- B20
- EQ
- FW
- WH
- 5/10 DAY*  

**ORDERING**

- Luminaire Series FLUL
- Nominal Size 22
- Shielding PS
- Lumen Output
- Lumen Output
- Lumen Output
- Lumen Output
- Color Temperature
- Color Temperature
- Color Temperature
- Circuit 1C
- Voltage 120 Volt
- Voltage 277 Volt
- Voltage UNV Volt
- Driver 0-10V - 10% Dimming LD1
- Driver Lutron A-Series L3D
- Driver 1% EcoSystem Digital 1% EcoSystem Digital
- Mounting 24" Aircraft Cable C24
- Mounting 48" Aircraft Cable C48
- Mounting 96" Aircraft Cable C96
- Mounting Drywall Frame Kit F
- Mounting Grid G
- Mounting Slot Tee ST
- Mounting Surface Mount SM
- Factory Options Air Return AR
- Factory Options Chicago Plenum CP
- Factory Options Bodine BSL110 Emergency Battery B310
- Factory Options Bodine BSL20 High Output Emergency Battery B20
- Factory Options 6' New York City Flex Whip FW
- Factory Options 6' Flex Whip FW
- Factory Options Finish Matte Satin White WH

**PERFORMANCE CHART**

<table>
<thead>
<tr>
<th>Delivered Lumens</th>
<th>Tested System Watts</th>
<th>LPW</th>
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<tbody>
<tr>
<td>2000 Lumens</td>
<td>23</td>
<td>87</td>
</tr>
<tr>
<td>2500 Lumens</td>
<td>31</td>
<td>81</td>
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<tr>
<td>3000 Lumens</td>
<td>39</td>
<td>77</td>
</tr>
<tr>
<td>3500 Lumens</td>
<td>47</td>
<td>74</td>
</tr>
</tbody>
</table>

*Lumen output may vary +/- 5%. Actual wattage may vary +/- 5%.

For more information visit focalpointlights.com/reference or consult factory. Quickship is a limited offering, visit focalpointlights.com/quickship for specifics.
CANDLEPOWER DISTRIBUTION

Vertical Angle 0° 22.5° 45° 67.5° 90°
0° 889 889 889 889 889
5° 883 883 883 883 883
10° 839 843 849 856 860
15° 700 706 714 723 734
20° 606 609 618 628 638
25° 517 539 565 626 652
30° 369 404 461 514 542
35° 236 264 323 361 387
40° 113 135 162 184 194
45° 25 29 33 36 39
50° 0 0 0 0 0
55° 0 0 0 0 0
60° 0 0 0 0 0
65° 0 0 0 0 0
70° 0 0 0 0 0
75° 0 0 0 0 0
80° 0 0 0 0 0
85° 0 0 0 0 0
90° 0 0 0 0 0
95° 0 0 0 0 0
100° 0 0 0 0 0
105° 0 0 0 0 0
110° 0 0 0 0 0
115° 0 0 0 0 0
120° 0 0 0 0 0
125° 0 0 0 0 0
130° 0 0 0 0 0
135° 0 0 0 0 0
140° 0 0 0 0 0
145° 0 0 0 0 0
150° 0 0 0 0 0
155° 0 0 0 0 0
160° 0 0 0 0 0
165° 0 0 0 0 0
170° 0 0 0 0 0
175° 0 0 0 0 0
180° 0 0 0 0 0

LUMEN SUMMARY

Zone Lumens % Fixtures
0-30° 685 27.4
0-40° 1121 44.9
0-60° 1981 79.0
0-90° 2489 100.0
Total Luminaire 0-180° 2500 100.0

LUMINANCE DATA (CD/M²)

Vertical Angle 0° 45° 90°
0° 2137 2421 2700
45° 1984 2351 2540
90° 1566 2234 3016
135° 1279 1829 2194
180° 833 1104 1369

Go to www.focalpointlights.com for additional photometric data.
The Horizon features a low-profile, minimalist square trim. A transitional design makes it a welcome addition to both contemporary and traditional applications. Spun from solid, non-ferrous 0.040” thick brass or 0.064” thick aluminum. Thermally formed acrylic ranges from 3/16” to 1/4” thick, depending on size. Virgin white acrylic is UV stable, and all faux acrylic colors are mixed completely through to avoid noticeable fading. White acrylic is UL-94 HB Flame Class rated. OCL metal finishes are applied by hand and receive a protective clear coat lacquer. 21 standard powder coat paints offered, however all RAL colors available. Fixture offered with a variety of compact fluorescent and incandescent optic packages. Contact factory for additional modifications or options.
- Fixture mounts to a standard 4" J-box (supplied by others), and features a 45-degree sloped-ceiling canopy.
- Bodine® emergency ballast available, standard with remote mounted test switch and indicator light.
- Advance® and Lutron® dimming ballasts available. Controls not included.
- Integral HPF electronic fluorescent ballast with Class A sound rating (3-5 year ballast warranty depending on ballast specification).
- Dual circuiting is standard on multi-ballast fixtures. Consult factory for details or other circuiting options.
- Bottom finial option increases overall height by length of the finial.

For photometric data, please visit www.ocl.com.
For lamp and base information, see pages 496-505 in the reference section.
For metal halide lamping contact factory.
Structural mounting required for fixtures over 50 lbs.
For specific mounting instructions, please contact factory.
Five year product warranty.

Provide dimming ballast.
Provide equivalent LED lamps. Provide replacement lamp labeling on fixture.
The Horizon features a low-profile, minimalist square trim. A transitional design makes it a welcome addition to both contemporary and traditional applications. Spun from solid, non-ferrous 0.040" thick brass or 0.064" thick aluminum. Thermally formed acrylic ranges from 3/16" to 1/4" thick, depending on size. Virgin white acrylic is UV stable, and all faux acrylic colors are mixed completely through to avoid noticeable fading. White acrylic is UL-94 HB Flame Class rated. OCL metal finishes are applied by hand and receive a protective clear coat lacquer. 21 standard powder coat paints offered, however all RAL colors available. Fixture offered with a variety of compact fluorescent and incandescent optic packages. Contact factory for additional information or options.
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<th>SERIES</th>
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<th>SIZE</th>
<th>DIFFUSER</th>
<th>FINISH</th>
<th>LAMPING (PHOTOMETRIC TEST #:</th>
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</table>

- Fixture mounts to a standard 4" J-box (supplied by others), and features a 45-degree sloped-ceiling canopy.
- Advance® emergency ballast available, standard with remote mounted test switch and indicator light.
- Advance® and Lutron® dimming ballasts available. Controls not included.
- Integral HPF electronic fluorescent ballast with Class A sound rating (3-5 year ballast warranty depending on ballast specification).
- Dual circuiting is standard on multi-ballast fixtures. Consult factory for details or other circuiting options.
- Bottom finial option increases overall height by length of the finial.
- For photometric data, please visit www.ocl.com.
- For lamp and base information, see pages 496-505 in the reference section.
- Par down light option available in combination with a variety of compact fluorescent reflectors.
- For metal halide lamping contact factory.
- Structural mounting required for fixtures over 50 lbs.
- For specific mounting instructions, please contact factory.
- Five year product warranty.

For additional information go to www.ocl.com and search: HORIZON PENDANT
**HORIZON™ PENDANT**

- **HR1-P1ED-26-GW-BAL**

  - The Horizon features a low-profile, minimalist square trim.
  - A transitional design makes it a welcome addition to both contemporary and traditional applications.
  - Spun from solid, non-ferrous 0.040” thick brass or 0.064” thick aluminum.
  - Thermally formed acrylic ranges from 3/16” to 1/4” thick, depending on size. Virgin white acrylic is UV stable, and all faux acrylic colors are mixed completely through to avoid noticeable fading.
  - White acrylic is UL-94 HB Flame Class rated.
  - OCL metal finishes are applied by hand and receive a protective clear coat lacquer.
  - 21 standard powder coat paints offered, however all RAL colors available.
  - Fixture offered with a variety of compact fluorescent and incandescent optic packages.
  - Contact factory for additional modifications or options.

**MATCHING FIXTURES**

- **HR1-P1ED-26-GW-BAL**
- **HR1-P1AE-26-GW-BAL**

**FEATURES**

- The Horizon features a low-profile, minimalist square trim.
- A transitional design makes it a welcome addition to both contemporary and traditional applications.
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- Thermally formed acrylic ranges from 3/16” to 1/4” thick, depending on size. Virgin white acrylic is UV stable, and all faux acrylic colors are mixed completely through to avoid noticeable fading.
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- OCL metal finishes are applied by hand and receive a protective clear coat lacquer.
- 21 standard powder coat paints offered, however all RAL colors available.
- Fixture offered with a variety of compact fluorescent and incandescent optic packages.
- Contact factory for additional modifications or options.
### For Additional Information Go to www.ocl.com and Search: Horizon Pendant

#### Photometric Information


#### Lamp and Base Information

For lamp and base information, see pages 496-505 in the reference section.

#### Par Down Light Option

Par down light option available in combination with a variety of compact fluorescent reflectors.

#### Metal Halide Lamping

For metal halide lamping contact factory.

#### Structural Mounting

Structural mounting required for fixtures over 50 lbs.

#### Bottom Finial Option

Bottom finial option increases overall height by length of the finial.

---

### Table: Specifications

<table>
<thead>
<tr>
<th>SERIES</th>
<th>HANGING SYSTEM</th>
<th>SIZE</th>
<th>DIFFUSER</th>
<th>FINISH</th>
<th>LAMPPING</th>
<th>VOLTAGE</th>
<th>OAH</th>
<th>OPTIONS</th>
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<tr>
<td>P1AA</td>
<td>PENDANT WITH A SINGLE CENTER STEM</td>
<td>16</td>
<td>GW GLOSS WHITE ACRYLIC</td>
<td>PAL POLISHED ALUMINUM</td>
<td>16”</td>
<td>120</td>
<td>21</td>
<td>DMA ADVANCE® DIMMING BALLAST</td>
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<td>MW MATTE WHITE ACRYLIC</td>
<td>BAL BRUSHED ALUMINUM</td>
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<td>DML LUTRON® DIMMING BALLAST</td>
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<td>P1AE</td>
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<td>FA FAUX ALABASTER ACRYLIC</td>
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<td>26”</td>
<td>347</td>
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<td>EME INTEGRAL EMERGENCY</td>
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<td>P1AH</td>
<td>PENDANT WITH 3 ANGLED STEMS TO COLLECTOR AND A SINGLE CENTER STEM FROM TRIM RING TO CANOPY</td>
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<td>NH NATURAL HORN ACRYLIC</td>
<td>BBR BRUSHED BRASS</td>
<td>4002A 6032W GO</td>
<td>(109.89)</td>
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**Sample Code:** HR1–P1AE–24–GW–BAL–ATT32–120–30–DMA

**PHOTOMETRIC INFORMATION AVAILABLE AT WWW.OCLO.COM**

- Fixture mounts to a standard 4” J-box (supplied by others), and features a 45-degree sloped-ceiling canopy.
- Bodine® emergency ballast available, standard with remote mounted test switch and indicator light.
- Advance® and Lutron® dimming ballasts available. Controls not included.
- Integral HPF electronic fluorescent ballast with Class A sound rating (3-5 year ballast warranty depending on ballast specification).
- Dual circuiting is standard on multi-ballast fixtures. Consult factory for details or other circuiting options.
- Bottom finial option increases overall height by length of the finial.

**Provide Dimming Ballast**
**HORIZON™ PENDANT**

- The Horizon features a low-profile, minimalist square trim.
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- Spun from solid, non-ferrous 0.040" thick brass or 0.064" thick aluminum.
- Thermally formed acrylic ranges from 3/16" to 1/4" thick, depending on size. Virgin white acrylic is UV stable, and all faux acrylic colors are mixed completely through to avoid noticeable fading.
- White acrylic is UL-94 HB Flame Class rated.
- OCL metal finishes are applied by hand and receive a protective clear coat lacquer.
- 21 standard powder coat paints offered, however all RAL colors available.
- Fixture offered with a variety of compact fluorescent and incandescent optic packages.
- Contact factory for additional modifications or options.

**HR1-P1AA-26-WS-ORB**

**HR1-P1AH-26-GW-PBR**
FOR ADDITIONAL INFORMATION GO TO WWW.OCL.COM AND SEARCH: HORIZON PENDANT

SAMPLE CODE: HR1-P1AH-36-GW-PBR-4TT32-120-30-DMA

- Fixture mounts to a standard 4” J-box (supplied by others), and features a 45-degree sloped-ceiling canopy.
- Advance® emergency ballast available, standard with remote mounted test switch and indicator light.
- Integral HPF electronic fluorescent ballast with Class A sound rating (3-5 year ballast warranty depending on ballast specification).
- Dual circuiting is standard on multi-ballast fixtures. Consult factory for details or other circuiting options.
- Bottom finial option increases overall height by length of the finial.

- For photometric data, please visit www.ocl.com.
- For lamp and base information, see pages 496-505 in the reference section.
- For metal halide lamping contact factory.
- Structural mounting required for fixtures over 50 lbs.
- For specific mounting instructions, please contact factory.
- Five year product warranty.

PROVIDE DIMMING BALLAST

PROVIDE EQUIVALENT LED LAMPS. PROVIDE LABELING FOR REPLACEMENT LAMPS ON FIXTURE.
Focal Point LLC | 4141 S. Pulaski Rd, Chicago, IL 60632 | 773.247.9494 | focalpointlights.com | @focalpointlight

Photometric performance is measured in accordance with IESNA LM-79. Visit focalpointlights.com for complete photometric data. Visit energystar.gov for model specifics.

ID+ 6”
LED DOWNLIGHT

FEATURES

ChromaSure: Color consistency resulting in a 2-step MacAdam ellipse across the entire ID+ product line.

Field adjustability of ceiling thickness from 0.5” - 2.5”.

50° cutoff to light source and its image.

Selection of dimming drivers available.

Right Light: Standard delivered lumen outputs 1000, 1500, 2000, 2500 and 3000.

PERFORMANCE

PRODUCT OVERVIEW

Lumen Output: 1000-3000lm
Wattage: 11-36W
LPW: 83-94
Spacing Criteria: 1.09
SDCM: 2
Lumen L70 @ Maintenance: 63,000hrs

Delivered Lumens: 2000lm
Total System Watts: 21W

Clear Diffuse Reflector
3500k, 2000 Lumens

Delivered Lumens: 2000lm
Total System Watts: 21W

Photometric performance is measured in accordance with IESNA LM-79. Visit focalpointlights.com for complete photometric data. Visit energystar.gov for model specifics.

February 2017
HOUSING DETAILS

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<th>Standard</th>
<th>Emergency Battery</th>
<th>Chicago Plenum</th>
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<td>L x W x H</td>
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<tr>
<td>13.07” x 12.33” x 6.29”</td>
<td>16.21” x 12.33” x 6.29”</td>
<td>16.85” x 11.45” x 6.53”</td>
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</table>

HOUSING SPECIFICATIONS

Construction
Thermally protected housing for new construction applications. Insulation to be kept 3” away from housing. Butterfly brackets allow mounting to ½ emt. Order bar hangers as an accessory. Die-cast aluminum heat sink designed for maximum thermal dissipation. Die-formed housing and integral junction box with (7) 1/2” pry outs. UL & cUL listed for (6) #14 AWG (3 in, 3 out) 90°C conductors and feed through-branch wiring. Accommodates ceiling thicknesses up to 0.6” standard, field adjustable up to 2.5” thickness. For thicker ceiling consult factory. Fixture will not exceed 5 lbs.

Electrical
Choice of constant current dimming drivers. Power factor > .9 typical.

Emergency
Emergency Battery Pack: Bodine BSL17C-C2. Emergency output —7W for 90 minutes. Maximum mounting height: 23.3ft. (Black reflector color: 18.1ft.)

Labels
UL and cUL listed. Suitable for Dry or Damp Locations, indoor use only. Specify wet listed (WL) for recessed ceiling applications in indoor and outdoor locations. Lutron Drives not recommended for outdoor environments below 0°C.

Lumen Maintenance
Reported: L70 at >63,000 hours. Derived from EPA TM-21 calculator

Reliability
At Focal Point, our products are designed to stand the test of time. Each luminaire is engineered using superior components, manufactured with the utmost care and rigorously tested. Contact us for reliability data.

Warranty
LED System rated for operation in ambient environments up to 25°C. 5-year limited warranty.

TRIM & LED SPECIFICATIONS

LED System
Proprietary array incorporates premium LEDs on a robust platform. May be specified in 2700K, 3000K, 3500K or 4000K, CRI>80. Color accuracy within 2 SDCM. Aluminum heat sink provides appropriate thermal management.

Aesthetics
Parabolic reflector cone ensures glare free optics. Reflector is .050 spun aluminum. Torsion springs pull trim tight to the ceiling with no visible fasteners within the trim. Trims are self-flanged. Non-painted trim matches reflector finish. White painted flange may also be specified.

Optics
50-degree cut-off to light source and its image.

PERFORMANCE CHART

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<th>Delivered Lumens</th>
<th>System Watts</th>
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HOUSING ORDERING

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TRIM & LED MODULE

Aperture
6” Round Reflector LC6
6” Round Reflector - Emergency LC6EM

Trim Type
Round RN
Roupl Stroke EM

Lumen Output
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<td>RN</td>
<td>2500 Lumens 2500L</td>
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<td>RN</td>
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Color Temperature
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Optic
Downlight DN

Color
Clear Diffuse CD
Warm Diffuse WD
Black BK

Flange Finish
Non-Painted NP
Black Painted BP
White Painted WP

Factory Options
Wet Listed WL

A complete unit consists of two line items, housing and trim.

Example: FLC6D-R100L-200L-D11T-LH1-1% Dimming 2700K - 11L System Watts 1000L 88 LPW 277V*277

Example: FLC6D-R150L-250L-D11T-LH1-1% Dimming 3000K - 11L System Watts 1000L 88 LPW 277V*277

Focal Point LLC reserves the right to change specifications for product improvement without notification.

*Based on 3000/3500K. Clear Diffuse reflector cone. 80CRI Multipliers: 2700K: 0.94, 4000K: 0.146, 90CRI Multipliers: 2700K: 0.71, 3000/3500K: 0.9, 4000K: 0.89. Black Multiplier: 0.86. White Multiplier: 1.13. Lumen output may vary ±5%. Actual wattage may vary ±5%.
Go to www.focalpointlights.com for additional photometric data.

**Filename:** FLC6DRO2000L_35K_40K_DNCD.IES  **Lumens:** 2058

**Test #:** 1117169  **System Watts:** 22W  **LPW:** 94

**Zone Lumens % Fixture**

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<td>0-45°</td>
<td>2216</td>
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<td>0-60°</td>
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<td>Total Luminaires 0-180°</td>
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**FOOTCANDLE VALUES**

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<thead>
<tr>
<th>Distance from Source</th>
<th>Beam Diameter</th>
<th>Center Beam (FC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4'</td>
<td>5.3</td>
<td>113</td>
</tr>
<tr>
<td>6'</td>
<td>7.9</td>
<td>50</td>
</tr>
<tr>
<td>8'</td>
<td>10.6</td>
<td>26</td>
</tr>
<tr>
<td>10'</td>
<td>13.2</td>
<td>18</td>
</tr>
</tbody>
</table>

**FLC6D-RO-2500L-120-L11-T / LC6-RO-2500L-35K / 40K-DN-CD-NP**

**Filename:** FLC6DRO2500L_35K_40K_DNCD.IES  **Lumens:** 2500

**Test #:** 1117167  **System Watts:** 30W  **LPW:** 83

**Zone Lumens % Fixture**

<table>
<thead>
<tr>
<th>Zone</th>
<th>Lumens</th>
<th>%</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-30°</td>
<td>1624</td>
<td>66.5</td>
</tr>
<tr>
<td>0-45°</td>
<td>136</td>
<td>54.4</td>
</tr>
<tr>
<td>0-60°</td>
<td>18</td>
<td>7.2</td>
</tr>
<tr>
<td>90°</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Total Luminaires 0-180°</td>
<td>2058</td>
<td>100.0</td>
</tr>
</tbody>
</table>

**FOOTCANDLE VALUES**

<table>
<thead>
<tr>
<th>Distance from Source</th>
<th>Beam Diameter</th>
<th>Center Beam (FC)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4'</td>
<td>5.7</td>
<td>136</td>
</tr>
<tr>
<td>6'</td>
<td>7.9</td>
<td>60</td>
</tr>
<tr>
<td>8'</td>
<td>10.6</td>
<td>34</td>
</tr>
<tr>
<td>10'</td>
<td>13.2</td>
<td>22</td>
</tr>
</tbody>
</table>
ID+ 6"
LED DOWNLIGHT

CANDLEPOWER DISTRIBUTION

Vertical Angle | Horizontal Angle
---|---
0° | 0°
5° | 5°
10° | 10°
15° | 15°
20° | 20°
25° | 25°
30° | 30°
35° | 35°
40° | 40°
45° | 45°
50° | 50°
55° | 55°
60° | 60°
65° | 65°
70° | 70°
75° | 75°
80° | 80°
85° | 85°
90° | 90°

LUMEN SUMMARY

<table>
<thead>
<tr>
<th>Zone</th>
<th>Lumens</th>
<th>% Fixtures</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-30°</td>
<td>2186</td>
<td>70.4</td>
</tr>
<tr>
<td>0-45°</td>
<td>2887</td>
<td>93.0</td>
</tr>
<tr>
<td>0-60°</td>
<td>3091</td>
<td>99.6</td>
</tr>
<tr>
<td>Total</td>
<td>3104</td>
<td>100.0</td>
</tr>
</tbody>
</table>

FOOTCANDLE VALUES

Distance from Source | Beam Diameter (in) | Center Beam (FC)
---|---|---
4' | 7.2 | 88
6' | 9.0 | 75
8' | 10.5 | 42
10' | 13.1 | 27

Footcandle results based on AGI32; Reflectances=0/0/0; LLF=1

Go to www.focalpointlights.com for additional photometric data.
FEATURES & SPECIFICATIONS

INTENDED USE — The STL combines digital LED lighting and controls technologies with high-performance optical design to offer the most advanced surface-mount luminaire for general ambient lighting applications. High-efficacy light engine delivers long life and excellent color, ensuring a superior quality lighting installation that is highly efficient and sustainable.

CONSTRUCTION — Housing is roll formed from code-gauge steel.
Impact modified linear-faceted refractor with light diffusing film. Refractor attaches to die cast ends by simple hook and pin design with controlled tension provided by sonically welded end plate, providing secure installation and easy maintenance.
Decorative die-cast end caps provide added durability.
Finish: All metal parts are post-painted in white polyester powder coat for smooth, finished edges and uniform light distribution. Natural aluminum finish available on end caps (see Options).
Injection-molded plastic light traps prevent light leaks between shielding and end plates and centers diffuser on channel.

OPTICS — Volumetric illumination is achieved by creating an optimal mix of light to vertical and horizontal work surfaces, rendering interior space, objects and occupants in a more balanced luminous environment.
Light distribution is carefully controlled at high angles, providing just enough luminous flux to create the volumetric effect.
Angled mounting surface combined with crescent-shape linear faceted refractor system obscures and integrates individual LED images and uniformly washes fixture surface with light.

ELECTRICAL — Long-life LEDs, coupled with high-efficiency drivers, provide superior quantity and quality of illumination for extended service life. STL is rated to deliver L90 performance at 60,000 hours. The LEDs have a CRI of 82.
eldoLED driver options deliver choice of dimming range and choices for control, while assuring flicker-free, low-current inrush, 89% efficiency and low EMI.
Optional nLight® embedded controls continuously monitor system performance, allow for constant lumen management / compensation function, facilitate simple “plug-and-play” network and controls upgrading via Cat-5 cable. Ballast disconnect provided where required to comply with US and Canadian codes.

LISTINGS — CSA certified to meet U.S. and Canadian standards.
DesignLights Consortium® (DLC) Premium qualified product. Not all versions of this product may be DLC Premium qualified. Please check the DLC Qualified Products List at www.designlights.org/QPL to confirm which versions are qualified.
Patents pending. Damp listed.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Note: Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C. Specifications subject to change without notice.

---

**A+ Capable Luminaire**

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands’ specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® control networks when ordered with drivers marked by a shaded background
- This luminaire is part of an A+ Certified solution for nLight control networks, providing advanced control functionality at the luminaire level, when selection includes driver and control options marked by a shaded background

To learn more about A+, visit www.acuitybrands.com/aplus.

*See ordering tree for details
### STL4 LED Surface Volumetric

#### Ordering Information
Lead times will vary depending on options selected. Consult with your sales representative.

<table>
<thead>
<tr>
<th>STL4</th>
<th>Lumen Package</th>
<th>Voltage</th>
<th>Driver</th>
<th>Color Temperature</th>
<th>Control</th>
<th>Options</th>
<th>Finish</th>
</tr>
</thead>
<tbody>
<tr>
<td>4' surface volumetric LED</td>
<td>30L</td>
<td>3000K</td>
<td>L7EL</td>
<td>EZ1 eldoLED dimmable</td>
<td>EL7L</td>
<td>LED emergency battery pack (nominal 700 lumens); see Life Safety section</td>
<td></td>
</tr>
</tbody>
</table>

**Performance Data**

<table>
<thead>
<tr>
<th>Lumen Package</th>
<th>Input Watts</th>
<th>Lumin 1</th>
<th>LPW</th>
</tr>
</thead>
<tbody>
<tr>
<td>30L L9830</td>
<td>26.7</td>
<td>2594</td>
<td>106.8</td>
</tr>
<tr>
<td>30L L9835</td>
<td>26.7</td>
<td>2605</td>
<td>108.8</td>
</tr>
<tr>
<td>40L L9840</td>
<td>26.7</td>
<td>3195</td>
<td>119.7</td>
</tr>
<tr>
<td>50L L9850</td>
<td>26.7</td>
<td>3282</td>
<td>122.9</td>
</tr>
<tr>
<td>40L L9830</td>
<td>34.9</td>
<td>3688</td>
<td>105.7</td>
</tr>
<tr>
<td>50L L9835</td>
<td>34.9</td>
<td>3834</td>
<td>109.9</td>
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<tr>
<td>40L L9840</td>
<td>34.9</td>
<td>3979</td>
<td>114.0</td>
</tr>
<tr>
<td>60L L9850</td>
<td>34.9</td>
<td>4238</td>
<td>114.9</td>
</tr>
<tr>
<td>40L L9830</td>
<td>45.2</td>
<td>4615</td>
<td>102.1</td>
</tr>
<tr>
<td>50L L9850</td>
<td>45.2</td>
<td>5086</td>
<td>112.6</td>
</tr>
<tr>
<td>60L L9850</td>
<td>45.2</td>
<td>5094</td>
<td>112.6</td>
</tr>
</tbody>
</table>

**Notes**

1. Approximate lumen output.
2. Not available with EL battery packs or SLD drivers.
3. Not available with controls options.
5. Requires SC1 option. Dims to approximately 10% light output when unoccupied. See sensor details on the next page.
6. For additional paint finishes refer to: Architectural Colors.
STL4 LED Surface Volumetric

PHOTOMETRICS
STL4 40W E27 LP840, 3979 delivered lumens, test no. STL25690, tested in accordance to IESNA LM-79.

Specifications
Length: 46-3/8 (117.8)
Width: 10-1/8 (25.7)
Depth: 3-7/8 (9.8)
Weight: 13LB

All dimensions are inches (centimeters) unless otherwise noted.

Coefficients of Utilization

<table>
<thead>
<tr>
<th>Zone</th>
<th>Lumens</th>
<th>% Lamp</th>
<th>% Fixture</th>
</tr>
</thead>
<tbody>
<tr>
<td>0° - 30°</td>
<td>1043</td>
<td>26.2</td>
<td>26.2</td>
</tr>
<tr>
<td>0° - 40°</td>
<td>1668</td>
<td>41.9</td>
<td>41.9</td>
</tr>
<tr>
<td>0° - 60°</td>
<td>2829</td>
<td>71.1</td>
<td>71.1</td>
</tr>
<tr>
<td>0° - 90°</td>
<td>3703</td>
<td>93.1</td>
<td>93.1</td>
</tr>
</tbody>
</table>

Zonal Lumen Summary

<table>
<thead>
<tr>
<th>Zone</th>
<th>Lumens</th>
<th>% Lamp</th>
</tr>
</thead>
<tbody>
<tr>
<td>0° - 180°</td>
<td>3979</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Coef. pf = 20%
Coef. pc = 80%
Coef. pw = 70%

CP Summary

<table>
<thead>
<tr>
<th>CP Summary</th>
<th>pf</th>
<th>pc</th>
<th>pw</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°</td>
<td>1395</td>
<td>117</td>
<td>117</td>
</tr>
<tr>
<td>5°</td>
<td>1374</td>
<td>106</td>
<td>101</td>
</tr>
<tr>
<td>10°</td>
<td>1350</td>
<td>100</td>
<td>97</td>
</tr>
<tr>
<td>15°</td>
<td>1289</td>
<td>97</td>
<td>88</td>
</tr>
<tr>
<td>20°</td>
<td>1126</td>
<td>88</td>
<td>77</td>
</tr>
<tr>
<td>25°</td>
<td>911</td>
<td>81</td>
<td>69</td>
</tr>
<tr>
<td>30°</td>
<td>699</td>
<td>74</td>
<td>61</td>
</tr>
<tr>
<td>35°</td>
<td>507</td>
<td>69</td>
<td>55</td>
</tr>
<tr>
<td>40°</td>
<td>322</td>
<td>64</td>
<td>50</td>
</tr>
<tr>
<td>45°</td>
<td>158</td>
<td>59</td>
<td>46</td>
</tr>
<tr>
<td>50°</td>
<td>38</td>
<td>56</td>
<td>42</td>
</tr>
<tr>
<td>55°</td>
<td>3</td>
<td>52</td>
<td>39</td>
</tr>
</tbody>
</table>

Notes: 2’ configurations with emergency option cannot be stem mounted.

See ACCESSORIES below for hanging devices.

MOUNTING DATA
Suspension Kit Ceiling Types: F1 for use with most T-bar and screw slot grid ceiling applications. Designed for on-grid and off-grid installations.
F2 for use with recessed or surface-mount horizontal J-box applications.
For unit or row installation; surface or suspend mounting.
Individual installation — One double-stem or two single-stem hangers required.
For aircraft cable, one STACG_, STACGF_, or STACGE_ required for each suspension point.
For aircraft cable, one STACG_, STACGF_, or STACGE_ required for each suspension point.
For aircraft cable, one STACG_, STACGF_, or STACGE_ required for each suspension point.
Note: 2’ configurations with emergency option cannot be stem mounted.

See ACCESSORIES below for hanging devices.

DIMENSIONS
All dimensions are inches (centimeters) unless otherwise noted.

Specifications
Length: 46-3/8 (117.8)
Width: 10-1/8 (25.7)
Depth: 3-7/8 (9.8)
Weight: 13LB

<table>
<thead>
<tr>
<th>Specifications</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>46-3/8 (117.8)</td>
<td>A = 1/4 x 1/2 (6.35 x 1.27) Dual Hole</td>
<td></td>
</tr>
<tr>
<td>Width</td>
<td>10-1/8 (25.7)</td>
<td>B = 11/16 (1.71) Dia. K.O.</td>
<td></td>
</tr>
<tr>
<td>Depth</td>
<td>3-7/8 (9.8)</td>
<td>C = 7/16 (2.22) Dia K.O.</td>
<td></td>
</tr>
<tr>
<td>Weight</td>
<td>13LB</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

See diagram for additional details.
## FEATURES & SPECIFICATIONS

**INTENDED USE** — Built on the compact, low-profile Z strip channel, this LED strip offers long maintenance-free life, several color temperatures, lumen outputs and lengths. Ideal for new construction and retrofit applications in T8 lengths. Ideal for use in commercial, retail, manufacturing, warehouse, and display applications. Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate. [Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.]

**CONSTRUCTION** — Compact-design channel and cover are formed from code-gauge cold-rolled steel. Easy to install six-point row aligner included for continuous row mounting.

**Finish:** Paint options include high-gloss, baked white enamel (WH), or matte black (MB). Five-stage iron phosphate pre-treatment ensures superior paint adhesion and rust resistance.

**OPTICS** — Standard diffuse snap on/snap off lens eliminates pixels, improves uniformity and minimizes glare.

**ELECTRICAL** — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Optional internal pluggable wiring harness for reduced labor cost in row mounting applications (see PLR_ ordering information on page 3). Electronic LED driver is rated for 75 input watts maximum (see Operational Data on page two for actual wattage consumption), multi-volt input and 0-10V dimming standard. This fixture is designed to withstand a maximum line surge of 1.5kV at 0.75kA combination wave for indoor locations, for applications requiring higher level of protection additional surge protection must be provided.

LEDs provide 80CRI or 90 CRI at 3000 K, 3500 K, 4000 K or 5000 K. Lumen output up to 1,500 lumens per foot. Luminaire should be installed in applications where ambient temperatures do not exceed 86 °F (30 °C).

**INSTALLATION** — Fixture may be surface mounted (with or without ZSPRG hanger), pendant or stem mounted with appropriate mounting options. Six-point aligner locks in place for easy continuous row mounting.

**LISTINGS** — CSA certified to US and Canadian safety standards. For use in damp locations between -4 °F (-20 °C) and 86 °F (30 °C).

DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at [www.designlights.org/QPL](http://www.designlights.org/QPL) to confirm which versions are qualified.

**WARRANTY** — 5-year limited warranty. Complete warranty terms located at [www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx](http://www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx)

**Note:** Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25 °C. Specifications subject to change without notice.

---

### INDUSTRIAL ZL1D

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands’ specification for chromatic consistency
- This luminaire is part of an A+ Certified solution for nLight® or XPoint™ Wireless control networks marked by a shaded background.

To learn more about A+, visit [www.acuitybrands.com/aplus](http://www.acuitybrands.com/aplus).

*See ordering tree for details*
**ZL1D LED Striplight**

**Ordering Information**

**Notes**
1. See Operational Data on page 2 for actual lumens.
2. Not available with 0-10V dimming option.
4. See ordering information on page 3.
5. Must specify voltage. 120, 208, 240 or 277V.
6. Cordsets exit back of fixture unless OUTEND option is specified.
7. Order 2 for tandem double length fixtures (TZL1D).

<table>
<thead>
<tr>
<th>Series</th>
<th>Length</th>
<th>Nominal lumens</th>
<th>Diffuser</th>
<th>Voltage</th>
<th>Color temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>ZL1D</td>
<td>L24 24&quot;</td>
<td>1500LM 1,500 lumens</td>
<td>FST Drop lens</td>
<td>MVOLT 120-277V</td>
<td>30K 3000 K</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2500LM 2,500 lumens</td>
<td></td>
<td>120V</td>
<td>35K 3500 K</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3500LM 3,500 lumens</td>
<td></td>
<td>208V</td>
<td>40K 4000 K</td>
</tr>
<tr>
<td></td>
<td>L48 48&quot;</td>
<td>5000LM 5,000 lumens</td>
<td></td>
<td>240V</td>
<td>50K 5000 K</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7000LM 7,000 lumens</td>
<td></td>
<td>277V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>9600LM 9,000 lumens</td>
<td></td>
<td>347V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10000LM 10,000 lumens</td>
<td></td>
<td>480V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>14000LM 14,000 lumens</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TZL1D</td>
<td>L96 96&quot;</td>
<td>6000LM 6,000 lumens</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>10000LM 10,000 lumens</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>14000LM 14,000 lumens</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Color rendering index Options**

<table>
<thead>
<tr>
<th>Options</th>
<th>Color rendering index</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLR</td>
<td>80CRI 80 CRI</td>
</tr>
<tr>
<td>PLR/ILVG</td>
<td>90CRI 90 CRI</td>
</tr>
<tr>
<td>E7W</td>
<td>80CRI 80 CRI</td>
</tr>
<tr>
<td>OUTEND</td>
<td>90CRI 90 CRI</td>
</tr>
<tr>
<td></td>
<td>FST Drop lens</td>
</tr>
<tr>
<td></td>
<td>For 15/16” T-grid only</td>
</tr>
<tr>
<td></td>
<td>LSXR Sensor Switch® LSXR occupancy sensor¹</td>
</tr>
<tr>
<td></td>
<td>ZSPRG For 15/16” T-grid only</td>
</tr>
<tr>
<td></td>
<td>WSG24 24” wireguard, white</td>
</tr>
<tr>
<td></td>
<td>WSG48 48” wireguard, white²</td>
</tr>
</tbody>
</table>

**Accessories**

Order as separate catalog number.

<table>
<thead>
<tr>
<th>Accessories</th>
<th>Options</th>
</tr>
</thead>
<tbody>
<tr>
<td>HC36</td>
<td>Hanger chain, 36&quot;</td>
</tr>
<tr>
<td>ZACVH</td>
<td>Aircraft cable 10’ (one pair)</td>
</tr>
<tr>
<td>ZLANGBK8T</td>
<td>Luma-tilt™ angle bracket for shelf or ledge mounting only</td>
</tr>
<tr>
<td>NPP16D</td>
<td>eLight® switching/dimming module</td>
</tr>
</tbody>
</table>

**Notes**
1. See Operational Data on page 2 for actual lumens.
2. Not available with 0-10V dimming option.
4. See ordering information on page 3.
5. Must specify voltage. 120, 208, 240 or 277V.
6. Cordsets exit back of fixture unless OUTEND option is specified.
7. Order 2 for tandem double length fixtures (TZL1D).
**ZL1D LED Striplight**

### OPERATIONAL DATA

<table>
<thead>
<tr>
<th>Nominal lumen package</th>
<th>Length (inches)</th>
<th>Delivered lumens 3000 K CCT @ 77°F (25°C) ambient temperature</th>
<th>Delivered lumens 3500 K CCT @ 77°F (25°C) ambient temperature</th>
<th>Delivered lumens 4000 K CCT @ 77°F (25°C) ambient temperature</th>
<th>Delivered lumens 5000 K CCT @ 77°F (25°C) ambient temperature</th>
<th>Wattage @120V</th>
<th>Comparable light source</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,500LM</td>
<td>24</td>
<td>1,966</td>
<td>2,013</td>
<td>2,047</td>
<td>2,141</td>
<td>18W</td>
<td>1-lamp 17W T8</td>
</tr>
<tr>
<td>2,500LM</td>
<td>24</td>
<td>2,679</td>
<td>2,734</td>
<td>2,808</td>
<td>2,832</td>
<td>22W</td>
<td>1-lamp 12W T8, 2-lamp 54W T5HO, 50W HID</td>
</tr>
<tr>
<td>3,500LM</td>
<td>24</td>
<td>4,210</td>
<td>4,295</td>
<td>4,412</td>
<td>4,450</td>
<td>39W</td>
<td>1-lamp 12W T8, 2-lamp 54W T5HO, 50W HID</td>
</tr>
<tr>
<td>3,000LM</td>
<td>48</td>
<td>3,740</td>
<td>3,830</td>
<td>3,894</td>
<td>4,073</td>
<td>33W</td>
<td>1-lamp 12W T8, 2-lamp 54W T5HO, 50W HID</td>
</tr>
<tr>
<td>5,000LM</td>
<td>48</td>
<td>5,245</td>
<td>5,352</td>
<td>5,497</td>
<td>5,544</td>
<td>42W</td>
<td>2-lamp 12W T8, 1-lamp 54W T5HO, 70W HID</td>
</tr>
<tr>
<td>7,000LM</td>
<td>48</td>
<td>7,403</td>
<td>7,553</td>
<td>7,754</td>
<td>7,825</td>
<td>67W</td>
<td>3-lamp 12W T8, 2-lamp 54W T5HO, 100W HID</td>
</tr>
<tr>
<td>6,000LM</td>
<td>96</td>
<td>7,431</td>
<td>7,609</td>
<td>7,737</td>
<td>8,093</td>
<td>60W</td>
<td>3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID</td>
</tr>
<tr>
<td>10,000LM</td>
<td>96</td>
<td>10,456</td>
<td>10,669</td>
<td>10,958</td>
<td>11,052</td>
<td>83W</td>
<td>4-lamp 32W T8, 2-lamp 54W T5HO, 100W HID</td>
</tr>
<tr>
<td>14,000LM</td>
<td>96</td>
<td>14,927</td>
<td>15,231</td>
<td>15,644</td>
<td>15,778</td>
<td>134W</td>
<td>4-lamp 32W T8, 3-lamp 54W T5HO, 150W HID</td>
</tr>
</tbody>
</table>

### DIMENSIONS

All dimensions are shown in inches (centimeters) unless otherwise noted. Specifications subject to change without notice.

#### PALLET DIMENSIONS

<table>
<thead>
<tr>
<th>Length</th>
<th>Approximate weight</th>
<th>Fixtures per pallet</th>
<th>Approximate pallet dimensions (L x W x H)</th>
</tr>
</thead>
<tbody>
<tr>
<td>124</td>
<td>7 lbs.</td>
<td>176</td>
<td>46&quot; X 5&quot; 1/2&quot; X 3 3/4&quot;</td>
</tr>
<tr>
<td>48</td>
<td>13 lbs.</td>
<td>176</td>
<td>46&quot; X 5&quot; 1/2&quot; X 3 3/4&quot;</td>
</tr>
<tr>
<td>96</td>
<td>26 lbs.</td>
<td>176</td>
<td>46&quot; X 9&quot; 1/2&quot; X 3 3/4&quot;</td>
</tr>
</tbody>
</table>

### PHOTOMETRICS

Please see www.lithonia.com.
ZL1D LED Striplight

PRODUCT INFORMATION
Advanced plug-in system with three-circuit capability. Available on industrial and strip products and a variety of architectural products mounted in continuous rows, 1, 2, 3, and 4-lamp fixtures. PLR22 (2-circuit) and PLR33 (3-circuit) crossover harness switches hot circuit serving next fixture in row. Reduces fixture types on job for alternating circuit applications (see example below.)

Easy one-step installation, saves up to 35% on labor costs. Expanded switching flexibility helps save energy. Rows can be 50% longer with two-circuit systems. Polarized, lock-together nylon connectors prevent miswiring in the field. #12 THHN conductor, rated 600V, 90°C. White neutral wire included. Grounding accomplished by fixture in-row connectors.

CSA certified systems available with up to 2 circuits. G ground required.

Note: Specifications subject to change without notice.

Wiring

### PLR

**Advanced 3-Circuit Plug-In**

**Typical Applications**
- Multiple-circuit and single-circuit for longer continuous rows
- Multiple-circuit with alternating fixtures on separate circuits, 2-circuit (PLR 22) and 3-circuit (PLR 33)
- Multiple circuit with night-lights located along row as desired

<table>
<thead>
<tr>
<th>Series</th>
<th>Number of hot wires</th>
<th>Branch circuits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLR</td>
<td>(blank)</td>
<td>Circuits to which ballast is connected</td>
</tr>
<tr>
<td>PLR22</td>
<td>1 Black</td>
<td>B Red wire</td>
</tr>
<tr>
<td>PLR33</td>
<td>2 Black and red</td>
<td>C Blue wire</td>
</tr>
<tr>
<td></td>
<td>3 Black, red and blue</td>
<td>A Black wire</td>
</tr>
</tbody>
</table>

**TYPICAL APPLICATIONS**

- **PLR 2 C**: Circuits B and C
- **PLR 3 C**: Circuits B, C, and A

**Series**

<table>
<thead>
<tr>
<th>Number of hot wires</th>
<th>Branch circuits</th>
</tr>
</thead>
<tbody>
<tr>
<td>PLR 22</td>
<td>Circuits to which ballast is connected</td>
</tr>
<tr>
<td></td>
<td>B Red wire</td>
</tr>
<tr>
<td></td>
<td>C Blue wire</td>
</tr>
<tr>
<td></td>
<td>A Black wire</td>
</tr>
</tbody>
</table>

**Series**

<table>
<thead>
<tr>
<th>Lens option</th>
<th>Dimming</th>
<th>Ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>No lens</td>
<td>LV</td>
<td>(blank)</td>
</tr>
<tr>
<td>High mount, 360°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High mount, 360° and aisleway</td>
<td></td>
<td></td>
</tr>
<tr>
<td>60</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low mount, 360°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>High mount aisleway</td>
<td></td>
<td></td>
</tr>
<tr>
<td>50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Small motion, 360°</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Voltage**

<table>
<thead>
<tr>
<th>Max dim level</th>
<th>Min dim level</th>
<th>Lead length</th>
<th>Temp humidity</th>
<th>Default time delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED Striplight</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>120-277 VAC (MVOLT)</td>
<td>9H 9V DC</td>
<td>1V 1V DC</td>
<td>LT Low temperature</td>
<td>5 minutes (with minimum 15 minutes on-time)</td>
</tr>
<tr>
<td>347-480 VAC</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For additional information see [www.lithonia.com](http://www.lithonia.com)

ORDERING INFORMATION
Lead times will vary depending on options selected. Consult with your sales representative.

**ORDERING INFORMATION**

**Example:** LSXR 10 ADC HVOLT 30M

**Series**

<table>
<thead>
<tr>
<th>Lens option</th>
<th>Dimming/photocell</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passive Infrared Sensor</td>
<td>(blank)</td>
</tr>
<tr>
<td>No lens</td>
<td>None</td>
</tr>
</tbody>
</table>

**Voltage**

<table>
<thead>
<tr>
<th>Max dim level</th>
<th>Min dim level</th>
<th>Lead length</th>
<th>Temp humidity</th>
<th>Default time delay</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 VDC</td>
<td>1V 1V DC</td>
<td>14&quot; 42L 42&quot;</td>
<td>LT Low temperature</td>
<td>5 minutes (with minimum 15 minutes on-time)</td>
</tr>
</tbody>
</table>

**ORDERING INFORMATION**

**LSXR**

**Voltage**

<table>
<thead>
<tr>
<th>120-277 VAC (MVOLT)</th>
<th>347-480 VAC</th>
<th>9H 9V DC</th>
<th>2V 2V DC</th>
<th>3V 3V DC</th>
<th>4V 4V DC</th>
<th>5V 5V DC</th>
<th>6V 6V DC</th>
<th>14&quot; 42L 42&quot;</th>
<th>LT Low temperature</th>
<th>5 minutes (with minimum 15 minutes on-time)</th>
</tr>
</thead>
</table>

For additional information see [www.lithonia.com](http://www.lithonia.com)

**ORDERING INFORMATION**

**Example:** LSXR 10 ADC HVOLT 30M
Z SERIES FIXTURE OPTIONS AND ACCESSORIES

The Z Series fixture offers numerous options for almost every electrical and optical component, including a long list of field-installable accessories.

**HANGER CHAIN**
36” chain with Y hanger.
Order as:
HC36

**Z SPRING HANGER**
Snap ‘n’ lock design requires no fasteners and can be used on T-grid ceiling or universal mounting systems.
Order as:
ZSPRG

**ZACVH HANGER**
10’ Aircraft cable with Y hanger.
Order as:
ZACVH

**ANGLE MOUNTING BRACKET**
Luma-tilt™ angle bracket ships as a pair.
Order as:
ZLANGBKT

**WIRE GUARD**
Order as:
WGZ24
WGZ48
Luna® 2x4
LED

DIMENSIONAL DATA

Overall height for ST luminaire is 5.5"

FEATURES
Architectural recessed LED luminaire with perforated center basket.
Classic style updated with the latest technology.
Reflector and end caps form seamless one-piece housing.
High reflectance, low gloss Matte White finish controls glare.
Comparable output to fluorescent versions with reduced wattage.
Luna® LED provides high angle uniform distribution ideal for comfortable general illumination.

PERFORMANCE

PRODUCT OVERVIEW

Lumen Output: 4000-5500lm
Wattage: 47-69W
LPW: 80-85
SDCM: 3
Lumen L90 @ Maintenance: 114,000hrs
Delivered Lumens: 5000lm
Total System Watts: 62W

Photometric performance is measured in accordance with IESNA LM-79.
Visit focalpointlights.com for complete photometric data.
MOUNTING INFORMATION

grid
specify "G" for flat 9/16" and 15/16" tee or "ST" for 5/16" set tee grid types.

drywall frame kit
specify "DF" Drywall Frame Kit for drywall ceiling conditions.

ORDERING

Luminaire Series  FLUL  FLUL
Nominal Size   2 x 4  24
Shielding  PS  PS
Perforated Shield  PS  PS
Lumen Output
4000 Lumens  4000L  4000L
4500 Lumens  4500L  4500L
5000 Lumens  5000L  5000L
5500 Lumens  5500L  5500L
Color Temperature
3000K  30K
3500K  35K
4000K  40K
Circuit
Single Circuit  1C  1C
Voltage
120 Volt  120
277 Volt  277
UNV Volt  UNV
Driver
0-10V - 10% Dimming  LD1
Lucent A-Series
1% EcoSystem Digital
400L, 4500L only. (2) drivers supplied, (2) EcoSystem addresses consumed
 consult factory for 3-wire control
Mounting
24" Aircraft Cable  C24
48" Aircraft Cable  C48
96" Aircraft Cable  C96
Drywall Frame Kit  F
Grid "G" flat tee "ST" slot tee
Slot Tee  ST
Surface Mount  SM
Factory Options
Air Return  AR
Chicago Plenum  CP
Bodine BSL310 Emergency Battery  B310
Bodine BSL30LV High Output  B20
Emergency Battery
Positional Clip  EQ
6" New York City Flex Whip  FNY
6" Flex Whip  FW
Finish  Matte Satin White  WH

SPECIFICATIONS

LED System
Proprietary linear LED module incorporates premium LEDs on a robust platform to achieve excellent thermal management. LEDs are placed to promote a uniform appearance. Available in 3000K, 3500K, or 4000K with CRI>80. 0-10V dimming driver standard. LED modules and drivers are replaceable.

Construction
One-piece 20 Ga. steel reflector and housing. 20 Ga. steel ends form finished housing. LEDs are shielded by detachable 22 Ga. steel perforated shield with acrylic lens insert. LED shield is secured by four spring–pins allowing shield to hinge down for maintenance. Top access 20 Ga. steel driver compartment. Weight: 29 lbs.

Optic
One-piece 20 Ga. steel reflectors finished in Matte Satin White powder coat.

Electrical
Standard 120-277V driver includes 0-10V analog dimming, dimming range 100% - 10% Power factor > .9.

Emergency Battery

Labels
UL and cUL Listed. Suitable for Dry or Damp Locations, indoor use only.

Finish
Polyester powder coat applied over a 5-stage pre-treatment.

Lumen Maintenance
Calculated: L90 at 114,000 hours  Reported: L90 at >61,000 hours
Derived from EPA TM-21 calculator

Lifetime and warranty
LED System rated for operation in ambient environments up to 25°C. 5 year limited warranty.

PERFORMANCE CHART

<table>
<thead>
<tr>
<th>Delivered Lumens</th>
<th>Tested System Watts</th>
<th>LPW</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000 Lumens</td>
<td>47</td>
<td>85</td>
</tr>
<tr>
<td>4500 Lumens</td>
<td>55</td>
<td>82</td>
</tr>
<tr>
<td>5000 Lumens</td>
<td>62</td>
<td>81</td>
</tr>
<tr>
<td>5500 Lumens</td>
<td>69</td>
<td>80</td>
</tr>
</tbody>
</table>

*Lumen output may vary +/- 5%. Actual wattage may vary +/- 5%.

For more information visit focalpointlights.com/reference or consult factory.
Quickship is a limited offering, visit focalpointlights.com/quickship for specifics.

Focal Point LLC reserves the right to change specifications for product improvement without notification.

LIGHTING FIXTURE CUTSHEETS  16512A - 30
Seem® 6
LED

Photometric performance is measured in accordance with IESNA LM-79. Visit focalpointlights.com for complete photometric data.

FEATURES
Narrow extruded aluminum 6" aperture recessed slot LED.
Integrates with ceiling or wall in a variety of mounting styles for a clean, unobtrusive aesthetic.
Individual units and continuous runs in 1" increments.
Frosted acrylic lens provides uninterrupted illumination, without pixels or shadows.
LED position and lens material optimized to provide the perfect blend of high performance and visual comfort.

PERFORMANCE

PRODUCT OVERVIEW
Lumen Output: 1500-4000lm
Wattage: 15-51W
LPW: 78-104
SDCM: 3
Reported Lumen L70 @ Maintenance: >60,000hrs

4' Flush Lens
625 Lumens per foot
Delivered Lumens: 2500lm
Total System Watts: 30W

DIMENSIONAL DATA

9/16 grid - flush lens shown

15/16 grid - regress lens shown

trimless mud-in
trim flange
grid
regress lens
corner detail
end detail
pop-down lens companion

note: 0.375” min - 2.125” max ceiling thickness
Focal Point LLC reserves the right to change specifications for product improvement without notification.

**SPECIFICATIONS**

**LED System**
Proprietary linear LED module incorporates premium LEDs on a robust platform to achieve excellent thermal management. LEDs are placed to promote a uniform appearance. Available in 3000K, 3500K, or 4000K with CRi>80. JSDCM. LED modules and drivers are replaceable from below.

**Construction**
One piece extruded aluminum housing. 20 Ga. steel end caps. Housing for new construction applications. XFW acceptable for use with wood, consult factory for Type IC availability. 2' unit weight: 18 lbs., 3' unit weight: 24 lbs., 4' unit weight: 30 lbs., 5' unit weight: 36 lbs.

**Optic**
Reflectors fabricated of 22 Ga. steel finished in High Reflectance White powder coat. Extruded acrylic lens 0.85” thick with satin finish, up to 8’ continuous.

**Electrical**
Luminaires are pre-wired with factory installed branch circuit wiring and over-molded quick connects. Standard 120-277V constant current driver includes 0-10V analog dimming. Dimming range 100% to 10%. Power factor > .9.

**Emergency Battery**

**Finish**
Polyester powder coat applied over a multi-stage pre-treatment. Suitable for Dry or Damp Locations, indoor use only.

**Lumen Maintenance**
Calculated: L70 at 105,000 hours Reported: L70 at >60,000 hours

**Reliability**
At Focal Point, our products are designed to stand the test of time. Each luminaire is engineered using superior components, manufactured with the utmost care and rigorously tested. Contact us for reliability data.

**Warranty**
LED system rated for operation in ambient environments up to 25°C. 5 year limited warranty.

**PERFORMANCE CHART**

<table>
<thead>
<tr>
<th>Shielding</th>
<th>Lumens per Foot</th>
<th>Delivered Lumens</th>
<th>Tested System Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Flux Lens</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>375LF</td>
<td>1500</td>
<td>18</td>
<td>83</td>
</tr>
<tr>
<td>875LF</td>
<td>3500</td>
<td>44</td>
<td>80</td>
</tr>
<tr>
<td>1000LF</td>
<td>4000</td>
<td>51</td>
<td>78</td>
</tr>
<tr>
<td><strong>Regress Lens</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>375LF</td>
<td>1500</td>
<td>17</td>
<td>88</td>
</tr>
<tr>
<td>875LF</td>
<td>3500</td>
<td>42</td>
<td>83</td>
</tr>
<tr>
<td>1000LF</td>
<td>4000</td>
<td>48</td>
<td>83</td>
</tr>
<tr>
<td><strong>Regress High Performance</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>375LF</td>
<td>1500</td>
<td>15</td>
<td>100</td>
</tr>
<tr>
<td>875LF</td>
<td>3500</td>
<td>36</td>
<td>97</td>
</tr>
<tr>
<td>1000LF</td>
<td>4000</td>
<td>41</td>
<td>98</td>
</tr>
</tbody>
</table>

*Based on 3500k, 4’ lengths. Lumen output may vary ± 5%. Actual wattage may vary ± 5%. Focal Point LLC reserves the right to change specifications for product improvement without notification.
FSM6L-FL-375LF-35K-LD1-WH-4'

System Watts: 1475W
Lumens: 1475
LPW: 85

LSM 6
LED - FLUSH LENS

CANDLEPOWER DISTRIBUTION

LUMEN SUMMARY

Vertical Angle 0° 22.5° 45° 67.5° 90°
Levels 252 258 267 538 957

FM6L-FL-625LF-35K-LD1-WH-4'

System Watts: 2465W
Lumens: 2465
LPW: 85

CANDLEPOWER DISTRIBUTION

LUMEN SUMMARY

Vertical Angle 0° 22.5° 45° 67.5° 90°
Levels 252 258 267 538 957

Go to www.focalpointlights.com for additional photometric data.
Go to www.focalpointlights.com for additional photometric data.

Go to www.focalpointlights.com for additional photometric data.
Go to www.focalpointlights.com for additional photometric data.
Vault™ 2x2

LED

DIMENSIONAL DATA

grid mount

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid Mount Width</td>
<td>24.00&quot;</td>
</tr>
<tr>
<td>Grid Mount Depth</td>
<td>1.13&quot;</td>
</tr>
</tbody>
</table>
| Flangeless Hard Surface

<table>
<thead>
<tr>
<th>Dimension</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flangeless Hard Surface Width</td>
<td>29.52&quot;</td>
</tr>
<tr>
<td>Flangeless Hard Surface Depth</td>
<td>749.6mm</td>
</tr>
<tr>
<td>Cut Out Dimensions</td>
<td>23.6875&quot; min - 23.75&quot; max</td>
</tr>
</tbody>
</table>

FEATURES

Architectural recessed indirect 2'x2' LED luminaire with vaulted reflector.

Concealed indirect LEDs create symmetrical distribution and provide visual comfort.

Vaulted reflector adds visual interest by creating the illusion of depth, a design that can only be achieved with LED.

PERFORMANCE

Delivered Lumens: 3000lm
Total System Watts: 34W

Photometric performance is measured in accordance with IESNA LM-79. Visit focalpointlights.com for complete photometric data.

LUMEN OUTPUT: 1000-4500lm
WATTAGE: 11-57W
LPW: 79-95
SDCM: 3
Lumen L90 @ Maintenance: 80,000hrs
**SPECIFICATIONS**

**LED System**
Proprietary linear LED module incorporates premium LEDs on a robust platform to achieve excellent thermal management. LEDs are placed to promote a uniform appearance.

**Available in** 2700K, 3000K, 3500K, 4000K, 5000K, 5700K or 6500K with CRI>80. 0-10V dimming driver standard. Color accuracy <3 SDCM. Driver is replaceable from above.

**Construction**

**Optic**
Concealed LEDs protected by acrylic covers indirectly illuminate white vaulted reflector.

**Electrical**
Standard 120-277V driver includes 0-10V analog dimming. Power factor > .9. Optional EcoSystem or forward phase dimming drivers from Lutron available.

**Emergency Battery**
Bodine BSL310-CAN. Emergency output—10 watts for 90 minutes. Maximum mounting height: 14ft.

**Lumen Maintenance**
Calculated: L90 at 80,000 hours. Reported: L90 at >60,000 hours.

**Reliability**
At Focal Point, our products are designed to stand the test of time. Each luminaire is engineered using superior components, manufactured with the utmost care and rigorously tested. Contact us for reliability data.

**Warranty**
LED system rated for operation in ambient environments up to 25°C. 5 year limited warranty.

**PERFORMANCE CHART**

<table>
<thead>
<tr>
<th>Delivered Lumens</th>
<th>Tested System Watts</th>
<th>LPW</th>
</tr>
</thead>
<tbody>
<tr>
<td>1000</td>
<td>11</td>
<td>91</td>
</tr>
<tr>
<td>2000</td>
<td>21</td>
<td>95</td>
</tr>
<tr>
<td>2500</td>
<td>27</td>
<td>93</td>
</tr>
<tr>
<td>3000</td>
<td>34</td>
<td>88</td>
</tr>
<tr>
<td>3500</td>
<td>41</td>
<td>85</td>
</tr>
<tr>
<td>4000</td>
<td>49</td>
<td>82</td>
</tr>
<tr>
<td>4500</td>
<td>57</td>
<td>79</td>
</tr>
</tbody>
</table>

* Based on 3500K. Lumen output may vary +/- 5%. Actual voltage may vary +/- 5%.

Focal Point LLC reserves the right to change specifications for product improvement without notification.
FVAL-22-CN-3000L-35K-LD1-G-WH

Lumens: 2995lm
System Watts: 33.8W
LPW: 88.6

Go to www.focalpointlights.com for additional photometric data.
Specifications

- Height: 7-1/8” (29.2 cm)
- Width: 16-3/8” (41.6 cm)
- Depth: 9-5/16” (23.6 cm)
- Weight (max): 30 lbs (13.6 kg)

**Introduction**

The Contour® Series luminaires offer traditional square dayforms with softened edges for a versatile look that complements many applications. The CSXW LED combines the latest in LED technology with the familiar aesthetic of the Contour® Series for stylish, high-performance illumination that lasts. It is ideal for replacing 100-400W metal halide in wall-mounted applications with typical energy savings of 80% and expected service life of over 100,000 hours.

**Ordering Information**

**EXAMPLE:** CSXW LED 30C 700 40K T3M MVOLT DDBXD

<table>
<thead>
<tr>
<th>CSXW LED</th>
<th>LEDs</th>
<th>Drive current</th>
<th>Color temperature</th>
<th>Distribution</th>
<th>Voltage</th>
<th>Mounting</th>
<th>Options</th>
<th>Notes</th>
<th>Finish (required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Series</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CSXW LED</td>
<td>30C</td>
<td>700 mA</td>
<td>40K</td>
<td>TYPE II, medium</td>
<td>120 V</td>
<td>Shipped included</td>
<td>Shipped separately *</td>
<td></td>
<td>DDBXD Dark bronze</td>
</tr>
<tr>
<td></td>
<td>30LED</td>
<td>1000 mA</td>
<td>50K</td>
<td>TYPE II, medium</td>
<td>208 V</td>
<td>Surface mount</td>
<td>Surface-mounted back box (for conduit entry)</td>
<td></td>
<td>DDBX Dark bronze</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>500K</td>
<td>TYPE II, medium</td>
<td>240 V</td>
<td></td>
<td></td>
<td></td>
<td>DDBXD Natural aluminum</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TYPE III, medium</td>
<td>277 V</td>
<td></td>
<td></td>
<td></td>
<td>DDBXD White</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TYPE IV, medium</td>
<td>340 V</td>
<td></td>
<td></td>
<td></td>
<td>DDBXD Textured dark bronze</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TYPE IV, medium</td>
<td>480 V</td>
<td></td>
<td></td>
<td></td>
<td>DDBXD Textured black</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TYPE IV, medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DDBXD Textured natural aluminum</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>TYPE IV, medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DDBXD Textured white</td>
</tr>
</tbody>
</table>

**Mounting Detail**

For use with fasteners

**Accessories**

- Back box accessory (specify finish)
- Wire guard accessory
- Vandal guard accessory

**NOTES**

1. Configured with 4000K (40K) provides the shortest lead times. Consult factory for 5000K (50K) lead times.
2. MVOLT driver operates on any line voltage from 120-277V (50/60 Hz). Specify 120, 208, 240 or 277 options only when ordering with fusing (SF, DF options) or photocell (PE option).
3. Available with 700 mA options only (30C 700).
4. Also available as a separate accessory; see Accessories information at left.
5. Photocell (PE) requires 120, 208, 240, 277 or 347 voltages. No option.
6. Must be ordered with fixture; cannot be field installed.
7. Single fuse (SF) requires 120, 277 or 347 voltages. Double fuse (DF) requires 208, 240 or 480 voltages. No option.
**Performance Data**

**Lumen Output**

Lumen values are from photometric tests performed in accordance with IESNA LM-79-08. Data is considered to be representative of the configurations shown, within the tolerances allowed by Lighting Facts. Contact factory for performance data on any configurations not shown here.

<table>
<thead>
<tr>
<th>LEDs</th>
<th>Drive Current (mA)</th>
<th>Performance Package</th>
<th>System Watts</th>
<th>Dist. Type</th>
<th>40K</th>
<th>50K</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Lumen B</td>
<td>U</td>
<td>G</td>
</tr>
<tr>
<td>700 mA</td>
<td>90C, 1000 - K</td>
<td>69W</td>
<td>7561</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>1000 mA</td>
<td>90C, 1000 - K</td>
<td>104W</td>
<td>7081</td>
<td>2</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>7924</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8802</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9312</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9528</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>9775</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>8142</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

**Lumen Ambient Temperature (LAT) Multipliers**

Use these factors to determine relative lumen output for average ambient temperatures from 0-40°C (32-104°F).

<table>
<thead>
<tr>
<th>Ambient Temperature</th>
<th>Lumen Multiplier</th>
</tr>
</thead>
<tbody>
<tr>
<td>0°C</td>
<td>1.00</td>
</tr>
<tr>
<td>10°C</td>
<td>0.94</td>
</tr>
<tr>
<td>25°C</td>
<td>0.91</td>
</tr>
<tr>
<td>40°C</td>
<td>0.85</td>
</tr>
</tbody>
</table>

**Projected LED Lumen Maintenance**

Data references the extrapolated performance projections for the CSXW LED platform in a 25°C ambient, based on 50,000 hours of LED testing (tested per IESNA LM-80-08 and projected per IESNA TM-21-11).

<table>
<thead>
<tr>
<th>Operating Hours</th>
<th>Lumen Maintenance Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.00</td>
</tr>
<tr>
<td>25,000</td>
<td>0.94</td>
</tr>
<tr>
<td>50,000</td>
<td>0.91</td>
</tr>
<tr>
<td>100,000</td>
<td>0.85</td>
</tr>
</tbody>
</table>

**Electrical Load**

<table>
<thead>
<tr>
<th>Number of LEDs</th>
<th>Drive Current (mA)</th>
<th>System Watts</th>
<th>Current (A)</th>
</tr>
</thead>
<tbody>
<tr>
<td>700</td>
<td>69W</td>
<td>90C</td>
<td>8.095</td>
</tr>
<tr>
<td>1000</td>
<td>104W</td>
<td>1000</td>
<td>12.34</td>
</tr>
</tbody>
</table>

**Photometric Diagrams**

To see complete photometric reports or download .ies files for this product, visit Lithonia Lighting’s CSXW homepage.

**Features & Specifications**

**Intended Use**

The Contour Series Wall LED Luminaire is ideal for commercial building mounted applications from over-the-door to 20 ft mounting heights.

**Construction**

Rugged, die-cast, single-piece aluminum housing. Unique flow-through design for optimized thermal management. Modularity allows for ease of maintenance and potential for future system upgrades. Metallic screen covers the top of the housing, preventing debris build-up while allowing for air flow. Housing is completely sealed against moisture and environmental contaminants.

**Finish**

Exterior parts are protected by a zinc-infused Super Durable TGIC thermoset powder coat finish that provides superior resistance to corrosion and weathering. A tightly controlled multi-stage process ensures a minimum 3 mils thickness for a finish that can withstand extreme climate changes without cracking or peeling.

**Optics**

Precision-molded acrylic lenses provide optimal luminaire spacing and improved uniformity. Lenses are indexed to the circuit board to ensure consistent optical alignment and delivering repeatable photometric performance. Light engines are available in standard 4000K (67 CRI) or optional 5000K (67 CRI) configurations. The CSXW has zero uplight and qualifies as a Nighttime Friendly™ product, meaning it is consistent with the LEED® and Green Globes™ criteria for eliminating wasteful uplight.

**Electrical**

Light engine consists of 30 high-efficiency LEDs mounted to a metal-core circuit board to maximize heat dissipation and promote long life (100,000 hrs at 40°C, 170). Class 1 electronic driver has a power factor >90%, THD <20%, and has an expected life of 100,000 hours with <1% failure rate. Easily-serviceable surge protection device meets a minimum Category C Low operation (per ANSI/IEEE C62.41.2).

**Installation**

Universal mounting mechanism with integral mounting support allows fixture to hinge down. Bubbled level provides correct alignment with every installation.

**Listings**

CSA-Certified to U.S. and Canadian standards. Rated for -40°C minimum ambient. Light engine is IP66 rated. Luminaire is IP65 rated.

DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org to confirm which versions are qualified.

**Warranty**


*Note: Specifications subject to change without notice.*

Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25°C.
FEATURES & SPECIFICATIONS

INTENDED USE — Ideal for wet location areas requiring emergency lighting that are subject to saturation with non-mechanically delivered water.

CONSTRUCTION — Gray, compact, low-profile contemporary design. Engineering-grade thermoplastic housing is impact-resistant, scratch-resistant and corrosion-proof. Rugged, heavy-duty, polycarbonate clear housing lens. UL94V-0 flame rating. UV-stable resin resists discoloration from natural and man-made light sources.

OPTICS — Lamp compatibility: Two 7W wedge-based halogen MR16 style lamps, with 45 degree adjustable heads in all directions.

ELECTRICAL — Dual-voltage input capacity (120V/277V). Emergency unit provided with test switch, status indicator and rechargeable battery.


WARRANTY — 3-year limited warranty. (Battery is prorated.) Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Actual performance may differ as a result of end-user environment and application.

Note: Specifications subject to change without notice.

ORDERING INFORMATION

WLTU MR

<table>
<thead>
<tr>
<th>Series</th>
<th>Housing color</th>
</tr>
</thead>
<tbody>
<tr>
<td>WLTU MR</td>
<td>Gray</td>
</tr>
</tbody>
</table>

Accessories: Order as separate catalog number 1

| ELA WG1 | Wireguard (back mount only) |

Catalog Number

<table>
<thead>
<tr>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
</tr>
</tbody>
</table>

Specifications

- Length: 14-7/8 (37.8)
- Depth: 4-1/4 (10.8)
- Height: 5-5/8 (14.3)
- Weight: 5.2 lbs (2.4 kg)

All dimensions are inches (centimeters) unless otherwise indicated.

Example: WLTU MR GY

NOTES

1 See spec sheet ELA-WG.
WLTU MR Wet Location Emergency Light

SPECIFICATIONS

**ELECTRICAL**

<table>
<thead>
<tr>
<th>Primary circuit</th>
<th>AC volts</th>
<th>Input watts</th>
<th>Max. amps</th>
<th>Output volts</th>
<th>Output watts¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>WLTU MR</td>
<td>120</td>
<td>6</td>
<td>0.06</td>
<td>6</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td>277</td>
<td>6.2</td>
<td>0.3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**BATTERY**

<table>
<thead>
<tr>
<th>Sealed lead calcium</th>
<th>Voltage</th>
<th>Shelf life²</th>
<th>Typical life³</th>
<th>Maintenance³</th>
<th>Optimum temperature⁴</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6</td>
<td>12 months</td>
<td>3-5 years</td>
<td>none</td>
<td>68° – 122°F (20° – 50°C)</td>
</tr>
</tbody>
</table>

Notes:
1. Based on 1-1/2 hour run time rating.
2. At 77°F (25°C).
3. All life safety equipment, including emergency lighting for path of egress, must be maintained, serviced and tested in accordance with all National Fire Protection Association (NFPA) and local codes. Failure to perform the required maintenance, service or testing could jeopardize the safety of occupants and will void all warranties.
4. Optimum ambient temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.

**LAMP PHOTOMETRICS**

MULTIPLE COVERAGE

Using multiple units at a typical 7.5' mounting height delivers 20' center-to-center spacing on a 3' path of egress.

Example of multiple units illuminating a 3' path of egress

See IES photometry at WLTU-WLTU-LED Photometry.
FEATURES & SPECIFICATIONS

INTENDED USE — Ideal for use in applications where smart, energy-efficient fixtures are desired. Typical applications include parking garages, canopies, transportation, schools, hospitals, cold storage and exterior retail environments where moisture or dust is a concern. Polycarbonate enclosure protects fixture while remaining easy to service and clean. Certain airborne contaminants can diminish the integrity of acrylic and/or polycarbonate. Click here for Acrylic-Polycarbonate Compatibility table for suitable uses.

CONSTRUCTION — UV-stabilized, injection-molded, impact-resistant, frosted polycarbonate housing with continuous poured-in-place, closed-cell gasket. 20-gauge steel channel and channel cover. Aluminum sheet metal board plate for thermal conduction and support. Captive, tamper-resistant, polycarbonate latches standard (8 Torx T-20 tamper-resistant screws included). Stainless steel latches also available. Fixture design allows for approximately 4% up-light.

OPTICS — UV-stabilized, injection-molded, impact-resistant, clear transparent and frosted, polycarbonate lens with aesthetic rib detail (.080” thick). When 2 aluminum reflector used to achieve wide distribution.

ELECTRICAL — Utilizes high-output LEDs integrated on a two-layer circuit board, ensuring cool-running operation. Electronic LED driver rated for 44 input watts and is standard 0-10V dimming. Integral GAV/IAA surge protection, tested in accordance to IEEE/ANSI standards. L85 at 60,000 hours.

INSTALLATION — Stainless steel surface mount brackets standard (2 included) allows for ceiling or suspended mount. A variety of stainless steel mounting options also available: J-box mounting and mounting brackets for suspension with aircraft cable (cable not included). Optional stainless steel V-hooks available for chain hanging (chain not included). Surface conduit entry on each end and on top. For horizontal and vertical mounting on a wall, application must be under a covered ceiling and QMB option recommended. 1/2” - 3/4” KO. When wall mounted the product will be rated for damp location only.

LISTINGS — CSA Certified to UL and C-UL standards. For use in ambient temperatures ranging from -20°F (-29°C) to 104°F (40°C). VAP LED is wet location listed for covered ceiling applications. IP65 and IP66 rated. VAP LED is NSF Splash Zone rated when suspended or ceiling mounted. When wall mounted the product will be rated for damp location only. DesignLights Consortium® (DLC) qualified product. Not all versions of this product may be DLC qualified. Please check the DLC Qualified Products List at www.designlights.org to confirm which versions are qualified.

WARRANTY — 5-year limited warranty. Complete warranty terms located at www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

Note: Actual performance may differ as a result of end-user environment and application.

All values are design or typical values, measured under laboratory conditions at 25°C. Specifications subject to change without notice.

---

**TYPE ODE - HOLDING CANOPY**

<table>
<thead>
<tr>
<th>Catalog Number</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Type</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**VAP LED**

**CEILING/ Suspend Mount**

---

**Lighting Fixture Cutsheet**

---

**Industry**: Industrial

**VAP-LED**

---

**Capable Luminaire**

This item is an A+ capable luminaire, which has been designed and tested to provide consistent color appearance and out-of-the-box control compatibility with simple commissioning.

- All configurations of this luminaire meet the Acuity Brands' specification for chromatic consistency.
- This luminaire is part of an A+ Certified solution for nLight® or XPoint™ Wireless control networks marked by a shaded background.

To learn more about A+, visit [www.acuitybrands.com/aplus](http://www.acuitybrands.com/aplus).

*See ordering tree for details*
VAP Linear Rough Service, LED

**ORDERING INFORMATION**

<table>
<thead>
<tr>
<th>VAP</th>
<th>Nominal lumens</th>
<th>Diffuser</th>
<th>Distribution</th>
<th>Voltage</th>
<th>Driver</th>
<th>Color temperature</th>
<th>CRI</th>
</tr>
</thead>
<tbody>
<tr>
<td>VAP</td>
<td>4000LM</td>
<td>4,000 lumens</td>
<td>FST Frosted polycarbonate lens</td>
<td>MD Medium</td>
<td>MVOLT MVOLT</td>
<td>GZ10 0–10V dimming</td>
<td>30K 300K</td>
</tr>
<tr>
<td></td>
<td>6000LM</td>
<td>6,000 lumens</td>
<td>PCL Clear polycarbonate lens</td>
<td>WD Wide</td>
<td>120V 277V</td>
<td>347V 480V</td>
<td>80CRI 80CRI</td>
</tr>
<tr>
<td></td>
<td>12000LM</td>
<td>12,000 lumens</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Options**

- **SF** Single fuse
- **BSL722** Bodine® emergency LED battery pack for 0°C and up
- **BSL722C** Bodine® emergency LED battery pack for -20°C and up
- **WLF** Wet location fitting (two outboard, top)
- **WLFIN** Wet location fitting (two inboard, top)
- **WLFEND** Wet location fitting (one end)
- **CS89** 6' white cord, 16/3, no plug, wet location
- **CS88** 12' Brad Harrison 16/3 cord and straight blade plug set
- **CS88L2** 12' Brad Harrison 16/3 cord and straight blade plug set

**Accessories:** Order as separate catalog number. (Ships separately)

- **VAPSMB** Surface-mount bracket
- **VAPQMB** Quick-mount ceiling bracket
- **VAPCMB** Chain-mount suspension bracket
- **VAPJSB** Junction box snap bracket
- **HC36** Wire hook and 36” chain set
- **RK1** T20BIT Hex base driver bit, Tamper resistant screws with center reject pin
- **RK1 T20DRV** Tamper resistant screws with center reject pin
- **STSL** Stainless-steel tamper resistant latch
- **QMB** Quick-mount ceiling bracket
- **MST10XAWL10M DSCXAWLX** Point™ wireless integral motion sensor, On/Off operation for motion sensing, override Off due to daylight
- **MST10NWL** Low mount 360° integral motion sensor, wet location, On/Off operation
- **MST102L3VWL** Low mount 360° integral motion sensor, wet location, High/Low operation (bi-level)
- **MST10NWL DSCNWL** Low mount 360° integral motion sensor, wet location, On/Off operation for motion sensing, override Off due to daylight
- **XAD** Point™ wireless controller, 0–10V dimming

**Notes**

1. Not available with BSL722 or BSL722C options.
2. 347V and 480V utilize a step-down transformer. Available 60Hz only.
3. For additional options, consult factory.
4. Must specify voltage.
5. Not available with 12000LM lumen package. Maximum ambient temperature 90°C.
6. Available in 120-277V only.
7. 5/8” long NPT threaded hub.
8. Not available with cord, sensor, or photocell options.
9. Required when using battery packs or cord sets that are not rated for wet locations.
10. Not available with BSL722 and BSL722C option.
11. Requires CMB (chain mount bracket) option.
12. For stainless steel, specify 316 (example: HC36 STS).
**VAP Linear Rough Service, LED**

**DIMENSIONS**

All dimensions are shown in inches (centimeters) unless otherwise noted.
Specifications subject to change without notice.

**MOUNTING ACCESSORIES**

- CMB - Ceiling Mounting Brackets
- JSB - Junction Box Mounting Bracket
- QMB - Quick-Mount Mounting Brackets
- SMB - Surface Mount Brackets (ship with fixture as standard)

**ARCHWAY™ PASSAGE™ LED Specification Matrix**

<table>
<thead>
<tr>
<th>Nominal lumens</th>
<th>Initial delivered lumens @ 80CRI with clear polycarbonate lens</th>
<th>Initial delivered lumens @ 80CRI with frosted polycarbonate lens</th>
<th>Wattage @120V</th>
<th>Comparable source</th>
</tr>
</thead>
<tbody>
<tr>
<td>4000LM</td>
<td>5,300 4,420 4,428 4,822</td>
<td>4,420 4,428 4,822</td>
<td>42</td>
<td>2-lamp 32W T8, 1-lamp 54W T5HO, 70W HID</td>
</tr>
<tr>
<td>6000LM</td>
<td>6,630 5,648 6,150</td>
<td>5,648 6,150</td>
<td>62</td>
<td>3-lamp 32W T8, 2-lamp 54W T5HO, 100W HID</td>
</tr>
<tr>
<td>12000LM</td>
<td>11,034 9,380 10,707</td>
<td>9,380 10,707</td>
<td>107</td>
<td>4-lamp 32W T8, 2-lamp 54W T5HO, 150W HID</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Operating hours</th>
<th>0</th>
<th>10,000</th>
<th>20,000</th>
<th>25,000</th>
<th>35,000</th>
<th>50,000</th>
<th>60,000</th>
<th>75,000</th>
<th>100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumen Maintenance Factor</td>
<td>1</td>
<td>.95</td>
<td>.92</td>
<td>.91</td>
<td>.89</td>
<td>.86</td>
<td>.84</td>
<td>.81</td>
<td>.77</td>
</tr>
</tbody>
</table>
VAP Linear Rough Service, LED

**SBOR - WET LOCATION Motion Sensor** (see [www.sensorswitch.com](http://www.sensorswitch.com) for additional information)
- 360° coverage
- On/Off dim
- Photocell optional
- IP66 rated
- Photocell and 0-10VDC dimming options.

<table>
<thead>
<tr>
<th>Fixture sensor nomenclature</th>
<th>SBOR sensor nomenclature</th>
</tr>
</thead>
<tbody>
<tr>
<td>For shortest lead times use one of the following SBOR configurations</td>
<td></td>
</tr>
<tr>
<td>MSI10WL</td>
<td>SBOR 10 OEX EB3 WH</td>
</tr>
<tr>
<td>MSI102L3VWL</td>
<td>SBOR 10 OEX D EB3 WH 3V</td>
</tr>
<tr>
<td>MSI10NWL DSCNWLS</td>
<td>SBOR 10 OEX P EB3 WH</td>
</tr>
</tbody>
</table>

**MOTION SENSOR**

<table>
<thead>
<tr>
<th>Series</th>
<th>Lens option</th>
<th>Dimming</th>
<th>Minimum dim level</th>
<th>Environmental factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSI</td>
<td>Passive infrared occupancy sensor</td>
<td>6 High mount, 360°</td>
<td>N Off, 2LXX Bi level range, CXX Continuous dim range, XA XPoint™ wireless signal to external system</td>
<td>0V Off, 1V 1VDC, 2V 2VDC, 3V 3VDC, 4V 4VDC, 5V 5VDC</td>
</tr>
<tr>
<td></td>
<td>10 Low mount, 360°</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PHOTOCELL** (must be ordered with MSI motion sensor, see above fixture sensor nomenclature table)

<table>
<thead>
<tr>
<th>Series</th>
<th>Dimming</th>
<th>Environmental factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>DSC</td>
<td>Passive infrared occupancy sensor with photocell</td>
<td>N Off, 2LXX Bi level range, CXX Continuous dim range, XA XPoint™ wireless signal to external system</td>
</tr>
</tbody>
</table>

**NOTES**
1. XX denotes dimming range (Ex. 3V, 4V, etc.)
**VAP Linear Rough Service, LED**

**COVERAGE PATTERNS**

**PARKING GARAGE / LOW MOUNT APPLICATIONS**

In general, the SBOR 10 is recommended for 8-15 ft (2.44-4.57 m) mounting and provides a coverage area radius for walking motion of greater than 2x the mounting height. The SBOR 10 ODP is ideal for parking garage and low pole mount applications. When mounted 10 ft high, for example, on a luminaire in a parking garage, the sensor's coverage for walking motion extends out 30 ft in a 360º pattern. This closely matches the lighting distribution of a typical parking garage luminaire. When mounted to a light pole, for example, in a parking lot or along a path, the sensor provides 270º of coverage (90º is blocked by the pole). Note, walking askew to sensor typically results in earlier detection than walking directly at sensor.

**SITE & AREA LIGHTING / HIGH MOUNT APPLICATIONS**

The SBOR 6 is intended for higher pole mount applications, between 15-30 ft (4.57-9.14 m), and provides a coverage area radius for walking motion of 15-20 ft (4.57-6.10 m). When mounted to a pole the sensor provides 270º of coverage (90º is blocked by the pole).
**KBC8 LED**

**LED Specification Bollard**

**TYPE OF - WALKWAY LIGHTING BOLLARDS**

---

**Introduction**

The KBC8 Bollard is a stylish, fully integrated LED solution for walkways. It features a sleek, modern design and is carefully engineered to provide long-lasting, energy-efficient lighting with a variety of optical and control options for customized performance.

With an expected service life of over 20 years of nighttime use and up to 70% in energy savings over comparable 100W metal halide luminaires, the KBC8 Bollard is a reliable, low-maintenance lighting solution that produces sites that are exceptionally illuminated.

---

**Ordering Information**

**EXAMPLE: KBC8 LED 16C 700 40K SYM MVOLT DDBXD**

<table>
<thead>
<tr>
<th>KBC8 LED</th>
<th>Series</th>
<th>LEDs</th>
<th>Drive current</th>
<th>Color temperature</th>
<th>Distribution</th>
<th>Voltage</th>
<th>Control options</th>
<th>Other options</th>
<th>Finish (required)</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Asymmetric</td>
<td>12C 12 LEDs°</td>
<td>350 450 mA</td>
<td>30K 3000 K</td>
<td>ASY Symmetrical</td>
<td>MVOLT°</td>
<td>Shipped installed</td>
<td>SF</td>
<td>Dark bronze</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Symmetric</td>
<td>16C 16 LEDs°</td>
<td>530 700 mA</td>
<td>50K 5000 K</td>
<td>AMBPC</td>
<td>H24</td>
<td>24&quot; overall height</td>
<td>DMG</td>
<td>White</td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMBLW</td>
<td>120°</td>
<td>208°</td>
<td>240°</td>
<td>277°</td>
<td>340°</td>
<td>ELCW</td>
<td>Emergency battery backup°</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMBLW</td>
<td>30&quot; overall height</td>
<td>36&quot; overall height</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMBLW</td>
<td>FG</td>
<td>Ground-fault test outlet</td>
<td>L/AB</td>
<td>Without anchor bolts (3 bolt base)</td>
<td>L/AB4</td>
<td>4 bolt retrofit base without anchor bolts°</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMBLW</td>
<td>DWGXD</td>
<td>Testasted natural aluminum</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>AMBLW</td>
<td>MWGXD</td>
<td>Testasted white</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**NOTES**

1. Only available in the 12C, ASY version.
2. Only available in the 16C, SYM version.
3. Only available with 450 AMBLW version.
4. Not available with DWGXD.
5. MVOLT driver operates on any line voltage from 120-277V (50/60 Hz). Specify 120, 208, 240 or 277 options only when ordering with fusing (SF, DF options), or photocontrol (PE option).
6. Not available with 347V. Not available with fusing. Not available with 450 AMBLW.
7. Single fuse (SF) requires 120, 277, or 347 voltage option. Double fuse (DF) requires 208 or 240 voltage option.
8. MRAB U is not available with L/AB4 option.
9. Stripping is available only in the colors listed.

---

**Accessories**

Ordered and shipped separately

MRAB U - Anchor bolts for KBC8 LED°

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**Conclusion**

The KBC8 Bollard offers a comprehensive range of features and options, making it an ideal choice for walkways and other outdoor lighting applications.
BID ISSUE
SHELBY TOWNSHIP
41-A DISTRICT COURT
16512A - 50

Performance Data

Lumen values are from photometric tests performed in accordance with IESNA LM-79-08. Data is considered to be representative of the configurations shown, with the tolerances allowed by Lighting Facts. Actual performance may differ as a result of end-user environment and application. Actual wattage may differ by ±8% when operating between 120-480V ±10%.

<table>
<thead>
<tr>
<th>Light Engines</th>
<th>WW</th>
<th>B</th>
<th>D</th>
<th>G</th>
<th>Lumen</th>
<th>WW</th>
<th>B</th>
<th>D</th>
<th>G</th>
<th>Lumen</th>
</tr>
</thead>
<tbody>
<tr>
<td>350 16</td>
<td>641</td>
<td>40</td>
<td>1</td>
<td>1</td>
<td>869</td>
<td>53</td>
<td>1</td>
<td>1</td>
<td>870</td>
<td>54</td>
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<tr>
<td>530 22</td>
<td>847</td>
<td>43</td>
<td>1</td>
<td>1</td>
<td>1,191</td>
<td>54</td>
<td>1</td>
<td>1</td>
<td>1,282</td>
<td>58</td>
</tr>
<tr>
<td>700 31</td>
<td>1,214</td>
<td>40</td>
<td>1</td>
<td>1</td>
<td>1,527</td>
<td>51</td>
<td>1</td>
<td>1</td>
<td>1,646</td>
<td>55</td>
</tr>
<tr>
<td>Amber 450 16</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>350 20</td>
<td>888</td>
<td>44</td>
<td>1</td>
<td>0</td>
<td>1,116</td>
<td>56</td>
<td>1</td>
<td>0</td>
<td>1,203</td>
<td>60</td>
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<tr>
<td>530 28</td>
<td>1,254</td>
<td>45</td>
<td>1</td>
<td>0</td>
<td>1,598</td>
<td>57</td>
<td>1</td>
<td>0</td>
<td>1,719</td>
<td>61</td>
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<tr>
<td>700 39</td>
<td>1,608</td>
<td>41</td>
<td>1</td>
<td>0</td>
<td>2,022</td>
<td>52</td>
<td>1</td>
<td>0</td>
<td>2,180</td>
<td>56</td>
</tr>
<tr>
<td>Amber 450 20</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Available with phosphor-converted amber LED’s (nomenclature AMBPC). These LED’s produce light with 97+% >530 nm. Output can be calculated by applying a 0.7 factor to 4000 K lumen values and photometric files.

Projected LED Lumen Maintenance

Data references the extrapolated performance projections for the platforms noted in a 25°C ambient, based on 10,000 hours of LED testing (tested per IESNA EM-40-08 and projected per IESNA TM-21-11).

To calculate LLF, use the lumen maintenance factor that corresponds to the desired number of operating hours below. For other lumen maintenance values, contact factory.

<table>
<thead>
<tr>
<th>Operating Hours</th>
<th>0</th>
<th>25,000</th>
<th>50,000</th>
<th>100,000</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lumen Maintenance Factor</td>
<td>1.00</td>
<td>0.98</td>
<td>0.97</td>
<td>0.95</td>
</tr>
</tbody>
</table>

Electrical Load

<table>
<thead>
<tr>
<th>Light Engines</th>
<th>Drive Current</th>
<th>Watts</th>
</tr>
</thead>
<tbody>
<tr>
<td>12C</td>
<td></td>
<td></td>
</tr>
<tr>
<td>350</td>
<td>16W</td>
<td>0.118</td>
</tr>
<tr>
<td>530</td>
<td>22W</td>
<td>0.169</td>
</tr>
<tr>
<td>700</td>
<td>31W</td>
<td>0.183</td>
</tr>
<tr>
<td>Amber 450</td>
<td>16W</td>
<td>0.186</td>
</tr>
<tr>
<td>350</td>
<td>20W</td>
<td>0.157</td>
</tr>
<tr>
<td>530</td>
<td>28W</td>
<td>0.192</td>
</tr>
<tr>
<td>700</td>
<td>39W</td>
<td>0.209</td>
</tr>
<tr>
<td>Amber 450</td>
<td>20W</td>
<td>0.199</td>
</tr>
</tbody>
</table>

Photometric Diagrams

To see complete photometric reports or download .ies files for this product, visit Lithonia Lighting’s KBC8 Bollard homepage.

FEATURES & SPECIFICATIONS

INTENDED USE

The rugged construction and clean lines of the KBA bollard is ideal for illuminating building entryways, walking paths, and pedestrian plazas, as well as any other location requiring a low mounting height light source with fully cutoff illumination.

CONSTRUCTION

One-piece 8-inch round extruded aluminum shaft with thick side walls for extreme durability, a high-impact clear acrylic lens and welded top cap. Die-cast aluminum mounting ring allows for easy leveling even in sloped locations and a full 360-degree rotation for precise alignment during installation. Three ½” x 11” anchor bolts with double nuts and washers and 3 ¾” bolt circle template ensure stability.

FINISH

Exterior parts are protected by a zinc-infused superior durable TGIC thermoset powder coat finish that provides superior resistance to corrosion and weathering for maximum retention of gloss and luster. A tightly controlled multi-stage process ensures a minimum 3-mil thickness for a finish that can withstand the elements without cracking or peeling. Available in both textured and non-textured finishes.

OPTICS

Two fully cutoff optical distributions are available: symmetrical and asymmetrical. Limited-wavelength amber LED’s are also available.

ELECTRICAL

Light engines consist of high-efficacy LEDs mounted to metal-core circuit boards to maximize heat dissipation and promote long life (95/100,000 hours at 700mA at 25°C). Class 2 electronic drivers are designed for an expected life of 100,000 hours with < 1% failure rate. Electrical components are mounted on a removable power tray.

LISTINGS

CSA certified to U.S. and Canadian standards. Light engines are IP66 rated. Rated for -40°C minimum ambient. Cold-weather emergency battery backup rated for -20°C minimum ambient.

WARRANTY


Note: Specifications subject to change without notice.
Monaco 3000 series is a small scale, versatile, LED, HID or incandescent inground illuminator for use with T4.5, T6, T3.5; PAR20 and PAR30 metal halide lamps or LED. The adjustable versions, 3000A, 3001A and 3002A provide up to 25° tilt and 360° rotation of the lamp beam allowing for precision aiming. The non-adjustable versions, 3000N, 3001N and 3002N provide a fixed uplight. The Monaco 3000 is ideal for uplighting building facades, trees, columns, and other interesting site features.

**SPECIFICATION FEATURES**

- **Material**: Recessed housing is constructed from corrosion-proof, injection molded polyphenylene sulfide (PPS). Trim ring is constructed from corrosion-resistant brass or stainless steel.

- **Finish**: Painted trim rings are constructed from solid brass with a polyester powdercoat paint finish. A variety of standard colors is available. Machined natural brass or stainless steel trim rings are unpainted and available in either round or square forms. Brass will patina naturally over time.

- **Lens**: Domed 1/2" thick tempered glass lens, factory sealed with high temperature gasket to prevent water intrusion. Suitable for drive-over applications to 5000 lbs.

- **Hardware**: Stainless steel hardware is standard to provide maximum corrosion-resistance. Outer trim ring includes captive fasteners.

- **Electrical**: LED fixtures include an integral, universal input driver (120V - 277V).

- **LED Light Engine**: LED light engine is included and comes equipped with (7) 3-watt white LEDs. Factory configurable optics allow for four optical distributions. High CRI of 85 with excellent color consistency of +/-50K color temperature.

- **Dimming**: The LED light engine is dimmable to 15% with electronic low voltage equipment (ELV dimmers need a neutral connection in the wall box).

- **Warranty**: Lumière warrants it's fixtures against defects in materials & workmanship for three (3) years. Driver carries the original manufacturer’s warranty.

- **Recessed Housing**: Recessed housing is provided with two ¾ inch NPS threaded conduit entries. The recessed housing is available to ship in advance of complete fixture for rough-in purposes. Specify option -LBB and order recessed housing and accompanying components from below:
  - **Recessed housing**: 3000-BBR, 3000-BBS
  - **Recessed housing with fusing**: 3000-BBR-FUS, 3000-BBS-FUS

**CERTIFICATION DATA**

- UL and cUL Wet Location Listed
- LM79 / LM80 Compliant
- ROHS Compliant
- IP67 Ingressed Protection Rated

**TECHNICAL DATA**

- 18 Watt Max. LED
- 40°C Maximum Temperature Rating

**APPLICATIONS: ADJUSTABLE INGROUND**

**ORDERING INFORMATION**

Sample Number: 3002A-18LED4000-MFL-CLR-UNV-6Z

<table>
<thead>
<tr>
<th>Series</th>
<th>Trim</th>
<th>Source</th>
<th>Distribution</th>
<th>Top Glass</th>
<th>Voltage</th>
<th>Finish</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>3002A-Monaco 3002</td>
<td>Square</td>
<td>18LED4000-18V LED</td>
<td>3000K, 65 CRI</td>
<td>MFL-25° Medium Flood WFL-40° Wide Flood</td>
<td></td>
<td>EZ-Bronze</td>
<td>FUS-Plating</td>
</tr>
</tbody>
</table>

**COORDINATE FINISH WITH ARCHITECT**

**AIM ANGLE APPROXIMATELY TO NEAR TOP OF EACH POLE. COORDINATE WITH FLAGPOLE MANUFACTURERS LIGHTING RECOMMENDATIONS**

**TYPE OG - FLAGPOLE LIGHTING**

- **41-A DISTRICT COURT**
- **SHELBY TOWNSHIP**
- **BID ISSUE**
- **0132-1001**

- **Lumière**

- **3002A LED**

- **APPLICATIONS: ADJUSTABLE INGROUND**

- **CERTIFICATION DATA**
  - UL and cUL Wet Location Listed
  - LM79 / LM80 Compliant
  - ROHS Compliant
  - IP67 Ingressed Protection Rated

- **TECHNICAL DATA**
  - 18 Watt Max. LED
  - 40°C Maximum Temperature Rating

- **COORDINATE FINISH WITH ARCHITECT**

- **AIM ANGLE APPROXIMATELY TO NEAR TOP OF EACH POLE. COORDINATE WITH FLAGPOLE MANUFACTURERS LIGHTING RECOMMENDATIONS**

- **TYPE OG - FLAGPOLE LIGHTING**

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- **0132-1001**

- **Lumière**

- **3002A LED**

- **APPLICATIONS: ADJUSTABLE INGROUND**

- **CERTIFICATION DATA**
  - UL and cUL Wet Location Listed
  - LM79 / LM80 Compliant
  - ROHS Compliant
  - IP67 Ingressed Protection Rated

- **TECHNICAL DATA**
  - 18 Watt Max. LED
  - 40°C Maximum Temperature Rating

- **COORDINATE FINISH WITH ARCHITECT**

- **AIM ANGLE APPROXIMATELY TO NEAR TOP OF EACH POLE. COORDINATE WITH FLAGPOLE MANUFACTURERS LIGHTING RECOMMENDATIONS**
### ACCESSORIES

<table>
<thead>
<tr>
<th>Filters (4.95” Diameter)</th>
<th>Optical Lenses (4.95” Diameter)</th>
<th>Optical Louvers (4.95” Diameter)</th>
<th>Light Control</th>
<th>Electrical</th>
</tr>
</thead>
<tbody>
<tr>
<td>F71-38 = Peach Dichroic</td>
<td>LSL-38=Linear Spread Lens (provides even illumination)</td>
<td>LVR-38=45° Hex Cell Louver (reduces glare)</td>
<td>3000-SG=Rock Guard</td>
<td>3000-FUS=Fusing Package</td>
</tr>
<tr>
<td>F72-38 = Amber Dichroic</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F73-38 = Green Dichroic</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F74-38 = Blue Dichroic</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F75-38 = Yellow Dichroic</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F76-38 = Red Dichroic</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F77-38 = Dark Blue Dichroic</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F78-38 = Light Blue Dichroic</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F79-38 = Neutral Density Dichroic</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F80-38 = Magenta Dichroic</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F22-38 = Red Color</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F33-38 = Blue Color</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F44-38 = Green Color</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F55-38 = Yellow Color</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F66-38 = Neutral Density Dichroic</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
<tr>
<td>F70-38 = Magenta Dichroic</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>DIF-38=Diffused Lens (provides even illumination)</td>
<td>3000-SG=Rock Guard</td>
<td></td>
</tr>
</tbody>
</table>

### PHOTOMETRY

**3002A-18LED3000-SP**
- Test No.: P166840
- CCT: 3000K
- Lumens: 967 Lm
- Watts: 16.6 W
- LPW: 58.3 Lm/W
- Beam Angle: 8.9°
- Field Angle: 17°
- CBCP: 3019 cd
- Cone of Light:
  - 10': 301.2 Lm/W
  - 20': 75.3 Lm/W
  - 30': 33.5 Lm/W
  - 40': 18.8 Lm/W

**3002A-18LED3000-NFL**
- Test No.: P166839
- CCT: 3000K
- Lumens: 971 Lm
- Watts: 16.6 W
- LPW: 58.5 Lm/W
- Beam Angle: 13.9°
- Field Angle: 24°
- CBCP: 14905 cd
- Cone of Light:
  - 10': 149.9 Lm/W
  - 20': 375 Lm/W
  - 30': 167 Lm/W
  - 40': 9.4 Lm/W

**3002A-18LED3000-MFL**
- Test No.: P166838
- CCT: 3000K
- Lumens: 912 Lm
- Watts: 16.6 W
- LPW: 55.5 Lm/W
- Beam Angle: 22.8°
- Field Angle: 48°
- CBCP: 4010 cd
- Cone of Light:
  - 10': 40.1 Lm/W
  - 20': 10 Lm/W
  - 30': 4.5 Lm/W
  - 40': 2.5 Lm/W

**3002A-18LED3000-WFL**
- Test No.: P166841
- CCT: 3000K
- Lumens: 947 Lm
- Watts: 16.6 W
- LPW: 57.0 Lm/W
- Beam Angle: 36°
- Field Angle: 53°
- CBCP: 2674 cd
- Cone of Light:
  - 10': 26.7 Lm/W
  - 20': 6.7 Lm/W
  - 30': 3 Lm/W
  - 40': 1.7 Lm/W

**3002A-18LED4000-SP**
- Test No.: P166844
- CCT: 4000K
- Lumens: 1113 Lm
- Watts: 16.7 W
- LPW: 66.6 Lm/W
- Beam Angle: 8.9°
- Field Angle: 17°
- CBCP: 34797 cd
- Cone of Light:
  - 10': 348 Lm/W
  - 20': 87 Lm/W
  - 30': 38.7 Lm/W
  - 40': 21.7 Lm/W

**3002A-18LED4000-NFL**
- Test No.: P166843
- CCT: 4000K
- Lumens: 1130 Lm
- Watts: 16.7 W
- LPW: 68.1 Lm/W
- Beam Angle: 14.1°
- Field Angle: 24°
- CBCP: 17220 cd
- Cone of Light:
  - 10': 172.2 Lm/W
  - 20': 43.1 Lm/W
  - 30': 19.1 Lm/W
  - 40': 10.8 Lm/W

**3002A-18LED4000-MFL**
- Test No.: P166842
- CCT: 4000K
- Lumens: 964 Lm
- Watts: 16.6 W
- LPW: 68.1 Lm/W
- Beam Angle: 21.3°
- Field Angle: 46°
- CBCP: 4753 cd
- Cone of Light:
  - 10': 475 Lm/W
  - 20': 11.9 Lm/W
  - 30': 5.3 Lm/W
  - 40': 3 Lm/W

**3002A-18LED4000-WFL**
- Test No.: P166845
- CCT: 4000K
- Lumens: 1070 Lm
- Watts: 16.7 W
- LPW: 64.0 Lm/W
- Beam Angle: 36°
- Field Angle: 53°
- CBCP: 2880 cd
- Cone of Light:
  - 10': 28.8 Lm/W
  - 20': 7.2 Lm/W
  - 30': 3.2 Lm/W
  - 40': 1.8 Lm/W
INSTALLATION NOTES

Caution: To prevent water, dirt and debris from collecting, install fixture to allow runoff. Do not install fixture in areas where water can collect for long periods of time. Appropriate drainage must be provided.

Excavated hole must be approximately 15" in diameter by 20" in depth. Fixture must be installed with a minimum 4" depth of pea gravel or equivalent drainage base. Backfill an additional 8" depth of pea gravel on lower portion of fixture for soil stability. For more detailed installation instructions and warnings consult factory.

Gravel Backfill

Bottom view of recessed housing showing two 3/4 inch NPS conduit entries.
TPR ENTERPRISES, LTD.

Description:

The **TPR WESTFLEX LED NEON** is a flexible Neon replacement product for use in Architectural and Entertainment venues. It comes in several color temperatures of white, solid colors and RGB. It is IP68 rated for submersible applications, has an extremely tight bend radius, and is UV protected for direct sunlight. Great for outlining buildings and creating curved lines of light, this product is also easily cut to length in the field.

Specifications:

<table>
<thead>
<tr>
<th>Construction:</th>
<th>PVC Ivory White</th>
</tr>
</thead>
<tbody>
<tr>
<td>Power:</td>
<td>3.7W/ft (RGB) 1.8W/ft (Solid Colors)</td>
</tr>
<tr>
<td>Operating Voltage:</td>
<td>24VDC</td>
</tr>
<tr>
<td>Operating Temp:</td>
<td>4F to 104F (-20C to 40C)</td>
</tr>
<tr>
<td>Dimensions:</td>
<td>0.46”W x 0.82”H</td>
</tr>
</tbody>
</table>

| Lamp Life:       | 50,000 hrs (70% lumen maintenance) |
| Min Bend Radius: | 4.75” |
| Min Cut Length:  | 4” |
| Max Run Lengths: | 32’ Single Feed 64’ Double Feed |

Certifications:

| TPR Westflex LED Neon Rounded Top | TPR Westflex LED Neon Flat Top |

Ordering Logic:

<table>
<thead>
<tr>
<th>MODEL</th>
<th>COLOR</th>
<th>PROFILE</th>
<th>LENGTH (to nearest 4”)</th>
<th>ACCESSORIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>FL-NEON</td>
<td>-</td>
<td>RGB 6500K</td>
<td>-</td>
<td>MT (Mounting Track)</td>
</tr>
<tr>
<td></td>
<td>5000K</td>
<td>R (Rounded)</td>
<td>-</td>
<td>MC (Mounting Clips)</td>
</tr>
<tr>
<td></td>
<td>3300K</td>
<td>F (Flat)</td>
<td>-</td>
<td>Consult Factory for Other Color Temperatures</td>
</tr>
</tbody>
</table>

644 Fayette Ave., Mamaroneck, NY 10543 | PHONE: 914.698.1141 | FAX: 914.698.9419 | E-MAIL: info@tprlights.com | www.tprlights.com
FEATURES & SPECIFICATIONS

INTENDED USE — Suitable for architectural applications where aesthetics and superior performance are required.

CONSTRUCTION — High-polish, injection-molded virgin acrylic panel, ultrasonically welded to eliminate visible hardware. Graduated depth of molded letters provides uniform light distribution on graphics. Standard housing finish is brushed aluminum.

Precision-molded, textured letters — 6" high with 3/4" stroke, with 100 ft viewing distance rating, based upon UL924 standard. Chevron indicator direction must be specified.

Recirculated rough-in section constructed of 20-gauge, die-formed galvanized steel. Extruded aluminum housing trim mounts flush onto wall or ceiling.

Mounting canopy for top mount is constructed of extruded aluminum housing to match housing finish.

ELECTRICAL — Sealed, maintenance-free nickel cadmium battery driven: 90 minutes capacity to lamp. Constant-current system changes, 24-hour recharge after 90-minute discharge.

Polarized battery connector simplifies installation and maintenance; prevents charger damage due to improper connection.

OPTICS — LEDs mounted on printed circuit board. The typical life of the exit LED lamp is 10 years.

Low energy consumption — EL N operation: only 2.3W for 120V single-face red sign; 1.7W for 120V single-face green sign. Non-emergency operation: only 1.5W for 120V single-face red sign; 1.2W for 120V single-face green sign.

INSTALLATION — Recessed mount – rough-in section for back, ceiling or end mounting. Fits into minimum wall or ceiling opening 13-5/8" L x 4-1/2" W x 3-1/8" D.

Adjustable T-bar hangers adapt mounting tray for mounting in suspended ceilings or variable-size framed openings. Trim ring has 3/4" variable depth adjustment to ensure flush fit against surface of wall or ceiling.

Plug-in wire connections and self-captive mounting screws for mounting panel/trim to rough-in section.

Top Mount (TM) — low-profile mounting canopy attaches exit to J-box. No rough-in section required.

LISTINGS — UL listed. Non-IC recessed mounting. Meets UL 924, NFP 101 (current Life Safety Code), NEC and OSHA illumination standards, and State of Minnesota requirements for less than 20W energy consumption. Listed and labeled to comply with Canadian Standards C-860 and C-22.2 No.9 (see options).

LISTINGS — UL listed. Non-IC recessed mounting. Meets UL 924, NFP 101 (current Life Safety Code), NEC and OSHA illumination standards, and State of Minnesota requirements for less than 20W energy consumption. Listed and labeled to comply with Canadian Standards C-860 and C-22.2 No.9 (see options).

WARRANTY — 5-year limited warranty, including lamps. Complete warranty terms located at: www.acuitybrands.com/CustomerResources/Terms_and_conditions.aspx

NOTE: Actual performance may differ as a result of end-user environment and application. All values are design or typical values, measured under laboratory conditions at 25°C. Specifications subject to change without notice.
LRP Precise® LED Exit Signs

SPECIFICATIONS

ELECTRICAL EMERGENCY

Primary Circuit

<table>
<thead>
<tr>
<th>Type</th>
<th>Typical LED life¹</th>
<th>Supply voltage</th>
<th>Number of faces</th>
<th>Input watts</th>
<th>Max. amps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red</td>
<td>10 years</td>
<td>120</td>
<td>1</td>
<td>2.3</td>
<td>.093</td>
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<tr>
<td></td>
<td></td>
<td>277</td>
<td>1</td>
<td>2.7</td>
<td>.095</td>
</tr>
<tr>
<td>Red</td>
<td>10 years</td>
<td>120</td>
<td>2</td>
<td>3.2</td>
<td>.084</td>
</tr>
<tr>
<td></td>
<td></td>
<td>277</td>
<td>2</td>
<td>3.9</td>
<td>.094</td>
</tr>
<tr>
<td>Green</td>
<td>10 years</td>
<td>120</td>
<td>1</td>
<td>1.7</td>
<td>.07</td>
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<tr>
<td>Green</td>
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<td>120</td>
<td>2</td>
<td>3.7</td>
<td>.14</td>
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<tr>
<td></td>
<td></td>
<td>277</td>
<td>2</td>
<td>3.8</td>
<td>.14</td>
</tr>
</tbody>
</table>

MOUNTING

All dimensions are in inches (centimeters).
Shipping weight for panel: 5 lbs. (2.3 kgs.)
Shipping weight for rough-in section: 5.8 lbs. (2.6 kgs.)

ELECTRICAL AC ONLY

Primary Circuit

<table>
<thead>
<tr>
<th>Type</th>
<th>Typical LED life¹</th>
<th>Supply voltage</th>
<th>Number of faces</th>
<th>Input watts</th>
<th>Max. amps</th>
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<tr>
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<td>1.5</td>
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<td></td>
<td></td>
<td>347</td>
<td>1</td>
<td>2.2</td>
<td>.107</td>
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<td>3.1</td>
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<td>347</td>
<td>2</td>
<td>4.1</td>
<td>.220</td>
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<td>Green</td>
<td>10 years</td>
<td>120</td>
<td>1</td>
<td>1.2</td>
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<td>120</td>
<td>2</td>
<td>2.0</td>
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<td></td>
<td></td>
<td>277</td>
<td>2</td>
<td>2.3</td>
<td>.06</td>
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BATTERY

Sealed Nickel-Cadmium

<table>
<thead>
<tr>
<th>Shelf life²</th>
<th>Typical life³</th>
<th>Maintenance³</th>
<th>Optimum temperature⁴</th>
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<tbody>
<tr>
<td>3 yrs.</td>
<td>7–9 yrs.</td>
<td>none</td>
<td>32°–100°F (0°–38°C)</td>
</tr>
</tbody>
</table>

Notes

1 Based on continuous operation. The typical life of the exit LED lamp is 10 years.
2 At 77°F (25°C).
3 All life safety equipment, including emergency lighting for path of egress, must be maintained, serviced, and tested in accordance with all National Fire Protection Association (NFPA) and local codes. Failure to perform the required maintenance, service, or testing could jeopardize the safety of occupants and will void all warranties.
4 Optimum ambient temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.

KEY FEATURES

- Silk-screening process allows customized text and/or graphics.
- Unique wedge-shaped panel design concentrates light for uniform letter illumination.
- Trim fits flush against wall or ceiling for clean, attractive appearance.
- Small rough-in section.

LA

RA

LRA (single face)

DA

LRA (double face)

Directional indicators

Specification

<table>
<thead>
<tr>
<th>LA</th>
<th>Back</th>
<th>Front</th>
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</thead>
<tbody>
<tr>
<td>RA</td>
<td></td>
<td></td>
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<tr>
<td>LRA (single face)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>DA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>LRA (double face)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Notes

1 Based on continuous operation. The typical life of the exit LED lamp is 10 years.
2 At 77°F (25°C).
3 All life safety equipment, including emergency lighting for path of egress, must be maintained, serviced, and tested in accordance with all National Fire Protection Association (NFPA) and local codes. Failure to perform the required maintenance, service, or testing could jeopardize the safety of occupants and will void all warranties.
4 Optimum ambient temperature range where unit will provide capacity for 90 minutes. Higher and lower temperatures affect life and capacity.
MILLENIUM METREX™
METSR SERIES

PRODUCT FEATURES:
- Semi-recessed wall mount – Single Face
- Indirect Red or Green LED
- Internal Battery Backup System
- 20-gauge cold rolled steel housing
- Self diagnostic testing features

SPECIFICATIONS
HOUSING: 20-gauge CRS. Hole-free one-piece seam welded construction.
FRAME: One-piece die-formed prime grade 16-gauge material as specified – see Ordering Information. Corners continuously seam welded and smooth with no post grinding (TIG).
LENS: External panel .188” thick clear polycarbonate.
LEGEND: Legend illuminated by internal high output LEDs. Lettering six inches high with .750” stroke. Polycarbonate red or green filter panels. High impact, punched, formed and painted sheet metal stencil and field selectable chevron inserts.
FASTENERS: Hardened security screws as specified – see ordering information.
FINISH: TGIC polyester powder coat – 5-stage pre-treatment. Salt spray test: 1,000 hours; Reflectance: 92%. See Options for black exterior.
ELECTRICAL: 624 nm Red or 527 nm Green LED light source. Electrical components mounted to removable high impact, injection molded polycarbonate chassis. Remote Exit Ready – can power one Kenall METSS Satellite Exit.
OPTIONS: Sealed nickel-cadmium Emergency Battery Pack (EL) with standard deep cycle battery conditioning, self test and self diagnostic circuitry, remote laser activated test switch, protected mechanical test switch and status indicator. Provides 120 minutes of emergency operation. Emergency Battery Pack (EL) suitable for 10°C to 45°C (50°F to 113°F). Cold Weather Emergency Battery Pack (CEL) suitable for -45°C to 45°C (-49°F to 113°F). (When used with a Kenall METSS, this fixture provides 90 minutes of emergency operation.)
LISTINGS: UL and CUL listed for Wet Location. UL certified IP65 in compliance with IEC 60598. Meets or exceeds UL924 and NFPA 101 standards. Meets or exceeds CSA and NRCAN requirements.

ORDERING INFORMATION (Ex: METSR-1-R-DT-1-EL)

<table>
<thead>
<tr>
<th>Model</th>
<th>Frame Material</th>
<th>Legend Color</th>
<th>Voltage</th>
<th>Fastener</th>
<th>Options</th>
<th>Accessories</th>
</tr>
</thead>
<tbody>
<tr>
<td>METSR</td>
<td></td>
<td></td>
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<td></td>
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</tr>
<tr>
<td>Frame Material</td>
<td>16-Ga CRS (Painted)</td>
<td>G</td>
<td>DT</td>
<td>120/277 Volts</td>
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<td></td>
</tr>
<tr>
<td>Legend Color</td>
<td>16-Ga SS (Painted)</td>
<td>R</td>
<td>DTC</td>
<td>120/347 Volts</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Options</td>
<td>16-Ga SS (Brushed)</td>
<td></td>
<td></td>
<td>Torx™ Head w/ Center Pin</td>
<td>1</td>
<td>LP</td>
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<tr>
<td>Fasteners</td>
<td>120227 Watts</td>
<td></td>
<td></td>
<td>Allen Head w/ Center Pin</td>
<td>2</td>
<td>9500</td>
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<tr>
<td>Voltage</td>
<td>120227 Watts</td>
<td></td>
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<td>120227 Watts</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

DIMENSIONAL DATA

SIDE VIEW

- Stud Spacing 16"
- Rough Opening 10.75" x 14.50"

MOUNTING DETAILS

- Frame 12.31” x 16.04”
- (4) 31” Dia. K.O.
- (4) 1/2” EMT K.O.
- 2.38”
- 16.00”
- 14.50”
- 10.75”
SECTION 16521 - EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
1.2 SUMMARY
1.3 DEFINITIONS
1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION
1.5 SUBMITTALS
1.6 QUALITY ASSURANCE
1.7 DELIVERY, STORAGE, AND HANDLING
1.8 WARRANTY
1.9 EXTRA MATERIALS

PART 2 - PRODUCTS

2.1 MANUFACTURERS
2.2 LUMINAIRES, GENERAL REQUIREMENTS
2.3 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS
2.4 ALUMINUM POLES
2.5 POLE ACCESSORIES

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION
3.2 POLE INSTALLATION
3.3 BOLLARD LUMINAIRE INSTALLATION
3.4 CORROSION PREVENTION
3.5 GROUNDING
3.6 FIELD QUALITY CONTROL
3.7 DEMONSTRATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Exterior luminaires with lamps and ballasts/drivers.
2. Poles and accessories.

B. Related Sections include the following:
1. Division 16 Section "Interior LED Lighting" for exterior luminaires normally mounted on exterior surfaces of buildings.

1.3 DEFINITIONS

A. CRI: Color-rendering index.

B. Luminaire: Complete lighting fixture, including ballast housing if provided.

C. Pole: Luminaire support structure, including tower used for large area illumination.

D. Standard: Same definition as "Pole" above.

1.4 STRUCTURAL ANALYSIS CRITERIA FOR POLE SELECTION

A. Dead Load: Weight of luminaire and its horizontal and vertical supports, lowering devices, and supporting structure, applied as stated in AASHTO LTS-4.

B. Ice Load: Load of 3 lbf/sq. ft., applied as stated in AASHTO LTS-4.

C. Wind Load: Pressure of wind on pole and luminaire, calculated and applied as stated in AASHTO LTS-4.

   1. Wind speed for calculating wind load for poles 50 feet or less in height is 110 mph.

1.5 SUBMITTALS

A. Product Data: For each luminaire, pole, and support component, arranged in order of lighting unit designation. Include data on features, accessories, finishes, and the following:

   1. Physical description of luminaire, including materials, dimensions, effective projected area, and verification of indicated parameters.
   2. Details of attaching luminaires and accessories.
   3. Details of installation and construction.
   4. Luminaire materials.
   5. Photometric data based on laboratory tests of each luminaire type, complete with indicated lamps, ballasts, and accessories.
a. Photometric data shall be certified by manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

6. Photoelectric relays.
7. Ballasts, including energy-efficiency data.
8. Lamps, including life, output, and energy-efficiency data.
10. Means of attaching luminaires to supports, and indication that attachment is suitable for components involved.
11. Anchor bolts for poles.
12. Manufactured pole foundations.

B. Shop Drawings:

1. Anchor-bolt templates keyed to specific poles and certified by manufacturer.
2. Design calculations, certified by a qualified professional engineer, indicating strength of screw foundations and soil conditions on which they are based.

C. Pole and Support Component Certificates: Signed by manufacturers of poles, certifying that products are designed for indicated load requirements in AASHTO LTS-4 and that load imposed by luminaire has been included in design.

D. Qualification Data: For agencies providing photometric data for lighting fixtures.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For luminaires and poles to include in emergency, operation, and maintenance manuals.

G. Warranty: Special warranty specified in this Section.
1.6 QUALITY ASSURANCE

A. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers' laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.


D. Comply with NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Package aluminum poles for shipping according to ASTM B 660.

B. Store poles on decay-resistant-treated skids at least 12 inches above grade and vegetation. Support poles to prevent distortion and arrange to provide free air circulation.

C. Retain factory-applied pole wrappings on metal poles until right before pole installation. For poles with nonmetallic finishes, handle with web fabric straps.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace products that fail in materials or workmanship; that corrode; or that fade, stain, perforate, erode, or chalk due to effects of weather or solar radiation within specified warranty period.

1. Warranty Period for Luminaires: Five years from date of Substantial Completion.

2. Warranty Period for Metal Corrosion: Five years from date of Substantial Completion.

3. Warranty Period for Color Retention: Five years from date of Substantial Completion.
4. Warranty Period for Lamps: Replace lamps and fuses that fail within 12 months from date of Substantial Completion; furnish replacement lamps and fuses that fail within the second 12 months from date of Substantial Completion.

5. Warranty Period for Poles: Repair or replace lighting poles and standards that fail in finish, materials, and workmanship within manufacturer's standard warranty period, but not less than three years from date of Substantial Completion.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

2. Glass and Plastic Lenses, Covers, and Other Optical Parts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

3. Ballasts: 10 for every 100 of each type and rating installed. Furnish at least one of each type.

4. Globes and Guards: 10 for every 20 of each type and rating installed. Furnish at least one of each type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. Basis of Design Product: The design of each item of exterior luminaire and its support is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.
2.2 LUMINAIRES, GENERAL REQUIREMENTS

A. Luminaires shall comply with UL 1598 and be listed and labeled for installation in wet locations by an NRTL acceptable to authorities having jurisdiction.

B. Comply with IESNA RP-8 for parameters of lateral light distribution patterns indicated for luminaires.

C. Metal Parts: Free of burrs and sharp corners and edges.

D. Sheet Metal Components: Corrosion-resistant aluminum, unless otherwise indicated. Form and support to prevent warping and sagging.

E. Housings: Rigidly formed, weather- and light-tight enclosures that will not warp, sag, or deform in use. Provide filter/breather for enclosed luminaires.

F. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Doors shall be removable for cleaning or replacing lenses. Designed to disconnect ballast when door opens.

G. Exposed Hardware Material: Stainless steel.

H. Plastic Parts: High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

I. Light Shields: Metal baffles, factory installed and field adjustable, arranged to block light distribution to indicated portion of normally illuminated area or field.

J. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:

1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.

K. Lenses and Refractors Gaskets: Use heat- and aging-resistant resilient gaskets to seal and cushion lenses and refractors in luminaire doors.
L. Luminaire Finish: Manufacturer's standard paint applied to factory-assembled and -tested luminaire before shipping. Where indicated, match finish process and color of pole or support materials.


1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.

3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

   a. Color: Medium bronze.

2.3 POLES AND SUPPORT COMPONENTS, GENERAL REQUIREMENTS

A. Structural Characteristics: Comply with AASHTO LTS-4.

1. Wind-Load Strength of Poles: Adequate at indicated heights above grade without failure, permanent deflection, or whipping in steady winds of speed indicated in Part 1 "Structural Analysis Criteria for Pole Selection" Article, with a gust factor of 1.3.

2. Strength Analysis: For each pole, multiply the actual equivalent projected area of luminaires and brackets by a factor of 1.1 to obtain the equivalent projected area to be used in pole selection strength analysis.

B. Luminaire Attachment Provisions: Comply with luminaire manufacturers' mounting requirements. Use stainless-steel fasteners and mounting bolts, unless otherwise indicated.
C. Mountings, Fasteners, and Appurtenances: Corrosion-resistant items compatible with support components.

1. Materials: Shall not cause galvanic action at contact points.
2. Anchor Bolts, Leveling Nuts, Bolt Caps, and Washers: Hot-dip galvanized after fabrication, unless stainless-steel items are indicated.
3. Anchor-Bolt Template: Plywood or steel.

D. Concrete Pole Foundations: Cast in place, with anchor bolts to match pole-base flange. Concrete, reinforcement, and formwork are specified in Division 3 Section "Cast-in-Place Concrete."

E. Power-Installed Screw Foundations: Factory fabricated by pole manufacturer, with structural steel complying with ASTM A 36/A 36M and hot-dip galvanized according to ASTM A 123/A 123M; and with top-plate and mounting bolts to match pole base flange and strength required to support pole, luminaire, and accessories.

F. Breakaway Supports: Frangible breakaway supports, tested by an independent testing agency acceptable to authorities having jurisdiction, according to AASHTO LTS-4.

2.4 ALUMINUM POLES

A. Poles: Seamless, extruded structural tube complying with ASTM B 429, Alloy 6063-T6 with access handhole in pole wall.

B. Poles: ASTM B 209, 5052-H34 marine sheet alloy with access handhole in pole wall.

1. Shape: As indicated. Refer to Section 16512A "Luminaire Cut Sheets".
2. Mounting Provisions: Butt flange for bolted mounting on foundation or breakaway support.

C. Pole-Top Tenons: Fabricated to support luminaire or luminaires and brackets indicated, and securely fastened to pole top.

D. Grounding and Bonding Lugs: Welded 1/2-inch threaded lug, complying with requirements in Division 16 Section "Grounding and Bonding," listed for attaching grounding
and bonding conductors of type and size listed in that Section, and accessible through handhole.

E. Brackets for Luminaires: Detachable, with pole and adapter fittings of cast aluminum. Adapter fitting welded to pole and bracket, then bolted together with stainless-steel bolts.

1. Tapered oval cross section, with straight tubular end section to accommodate luminaire.
2. Finish: Same as pole.

F. Prime-Coat Finish: Manufacturer's standard prime-coat finish ready for field painting.

G. Aluminum Finish: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

1. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.
2. Natural Satin Finish: Provide fine, directional, medium satin polish (AA-M32); buff complying with AA-M20; and seal aluminum surfaces with clear, hard-coat wax.
3. Class I, Clear Anodic Finish: AA-M32C22A41 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
4. Class I, Color Anodic Finish: AA-M32C22A42/A44 (Mechanical Finish: medium satin; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, integrally colored or electrolytically deposited color coating 0.018 mm or thicker) complying with AAMA 611.

a. Color: As selected by Architect from manufacturer's full range.

2.5 POLE ACCESSORIES

A. Duplex Receptacle: 120 V, 20 A in a weatherproof assembly complying with Division 16 Section "Wiring Devices" for ground-fault circuit-interrupter type.

1. Surface mounted, 12 inches above bottom of pole.
2. Nonmetallic polycarbonate plastic or reinforced fiberglass cover, color to match pole, that when mounted results in NEMA 250, Type 3R enclosure.
3. With cord opening.
4. With lockable hasp and latch that complies with OSHA lockout and tag-out requirements.

B. Minimum 1800-W transformer, protected by replaceable fuses, mounted behind access cover.

C. Base Covers: Manufacturers' standard metal units, arranged to cover pole's mounting bolts and nuts. Finish same as pole.

D. Transformer Type Base: Same material and color as pole. Coordinate dimensions to suit pole's base flange and accept indicated accessories.

E. Vibration Dampener: For all steel and aluminum lighting poles taller than 25’, provide factory installed vibration dampening device to eliminate second mode or higher resonance that can occur with low velocity steady state winds.

F. Decorative accessories, supplied by decorative pole manufacturer, include the following:
   1. Banner Arms: Where indicated
   2. Flag Holders: Where indicated
   3. Ladder Rests: Where indicated

PART 3 - EXECUTION

3.1 LUMINAIRE INSTALLATION


B. Install lamps in each luminaire.

C. Fasten luminaire to indicated structural supports.
   1. Use fastening methods and materials selected to resist seismic forces defined for the application and approved by manufacturer.

D. Adjust luminaires that require field adjustment or aiming.
3.2 POLE INSTALLATION

A. Align pole foundations and poles for optimum directional alignment of luminaires and their mounting provisions on the pole.

B. Clearances: Maintain the following minimum horizontal distances of poles from surface and underground features, unless otherwise indicated on Drawings:

1. Fire Hydrants and Storm Drainage Piping: 60 inches.
3. Trees: 15 feet.

C. Concrete Pole Foundations: Set anchor bolts according to anchor-bolt templates furnished by pole manufacturer. Concrete materials, installation, and finishing requirements are specified in Division 3 Section "Cast-in-Place Concrete."

D. Foundation-Mounted Poles: Mount pole with leveling nuts, and tighten top nuts to torque level recommended by pole manufacturer.

1. Use anchor bolts and nuts selected to resist seismic forces defined for the application and approved by manufacturer.
2. Grout void between pole base and foundation. Use nonshrink or expanding concrete grout firmly packed to fill space.
3. Install base covers, unless otherwise indicated.
4. Use a short piece of 1/2-inch- diameter pipe to make a drain hole through grout. Arrange to drain condensation from interior of pole.

E. Embedded Poles with Tamped Earth Backfill: Set poles to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.

1. Dig holes large enough to permit use of tampers in the full depth of hole.
2. Backfill in 6-inch layers and thoroughly tamp each layer so compaction of backfill is equal to or greater than that of undisturbed earth.
F. Embedded Poles with Concrete Backfill: Set poles in augered holes to depth below finished grade indicated on Drawings, but not less than one-sixth of pole height.

1. Make holes 6 inches in diameter larger than pole diameter.
2. Fill augered hole around pole with air-entrained concrete having a minimum compressive strength of 3000 psi at 28 days, and finish in a dome above finished grade.
3. Use a short piece of 1/2-inch-diameter pipe to make a drain hole through concrete dome. Arrange to drain condensation from interior of pole.
4. Cure concrete a minimum of 72 hours before performing work on pole.

G. Poles and Pole Foundations Set in Concrete Paved Areas: Install poles with minimum of 6-inch-wide, unpaved gap between the pole or pole foundation and the edge of adjacent concrete slab. Fill unpaved ring with pea gravel to a level 1 inch below top of concrete slab.

H. Raise and set poles using web fabric slings (not chain or cable).

3.3 BOLLARD LUMINAIRE INSTALLATION

A. Align units for optimum directional alignment of light distribution.

B. Install on concrete base with top 4 inches above finished grade or surface at bollard location. Cast conduit into base, and shape base to match shape of bollard base. Finish by troweling and rubbing smooth. Concrete materials, installation, and finishing are specified in Division 3 Section "Cast-in-Place Concrete."

3.4 CORROSION PREVENTION

A. Aluminum: Do not use in contact with earth or concrete. When in direct contact with a dissimilar metal, protect aluminum by insulating fittings or treatment.

B. Steel Conduits: Comply with Division 16 Section "Raceways and Boxes." In concrete foundations, wrap conduit with 0.010-inch-thick, pipe-wrapping plastic tape applied with a 50 percent overlap.
3.5 GROUNDING

A. Ground metal poles and support structures according to Division 16 Section "Grounding and Bonding."

B. Ground nonmetallic poles and support structures according to Division 16 Section "Grounding and Bonding."

3.6 FIELD QUALITY CONTROL

A. Inspect each installed fixture for damage. Replace damaged fixtures and components.

B. Illumination Observations: Verify normal operation of lighting units after installing luminaires and energizing circuits with normal power source.
   1. Verify operation of photoelectric controls.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain luminaire lowering devices. Refer to Division 1 Section "Demonstration and Training."

END OF SECTION 16521
SECTION 16714 - COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Backboards.
   2. Telecommunications service entrance pathways.

1.3 DEFINITIONS

A. Basket Cable Tray: A fabricated structure consisting of wire mesh bottom and side rails.

C. Channel Cable Tray: A fabricated structure consisting of a one-piece, ventilated-bottom or solid-bottom channel not exceeding 6 inches in width.

D. Ladder Cable Tray: A fabricated structure consisting of two longitudinal side rails connected by individual transverse members (rungs).

E. LAN: Local area network.

F. RCDD: Registered Communications Distribution Designer.

G. Solid-Bottom or Nonventilated Cable Tray: A fabricated structure consisting of a bottom without ventilation openings within integral or separate longitudinal side rails.

H. Trough or Ventilated Cable Tray: A fabricated structure consisting of integral or separate longitudinal rails and a bottom having openings sufficient for the passage of air and using 75 percent or less of the plan area of the surface to support cables.

1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install equipment frames and cable trays until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and work above ceilings is complete.

PART 2 - PRODUCTS

2.1 PATHWAYS

A. General Requirements: Comply with TIA/EIA-569-A.

B. Cable Support: NRTL labeled. Cable support brackets shall be designed to prevent degradation of cable performance and pinch points that could damage cable. Cable tie slots fasten cable ties to brackets.

1. Comply with NFPA 70 and UL 2043 for fire-resistant and low-smoke-producing characteristics.

2. Support brackets with cable tie slots for fastening cable ties to brackets.
3. J-hooks
4. Straps and other devices.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. APW.
   b. B-Line.
   c. Chatsworth Products, Inc.
   d. Homaco.

2. Description: 12 gauge tubular steel stringer style, with rungs 9" O.C. and rated for a load of 80 lbs/ft. minimum at 8' span.
3. Material: 3/8" x 1-1/2" tubular steel with 1/2" x 1" steel channel rungs, or equivalent.
4. Finish: Telco gray powder coat.
5. Width: 18 inches, or as indicated on drawings.
6. Provide manufacturer's standard hardware and accessories indicated and required to provide a complete system. Provide minimum 3/8" diameter threaded rod and mounting hardware for center hung cable runway.
7. Provide 6" H. side mount vertical retaining posts on each side at minimum 48" intervals to maintain cabling on runway, or vertical members integrally attached to rungs. Provide same finish color as runway.

D. Conduit and Boxes: Comply with requirements in Division 16 Section "Raceways and Boxes".
   1. Outlet boxes shall be no smaller than 4 inches wide, 4 inches high, and 2-1/2 inches deep.

2.2 BACKBOARDS

A. Backboards: Plywood, 3/4 by 48 by 96 inches. Comply with requirements for plywood backing panels specified in Division 6 Section "Rough Carpentry." Plywood sheets shall be free of all voids. Plywood shall have a minimum of two coats of fire-resistant, non-conducting paint applied to all sides of all sheets. Provide flush hardware and supports to mount plywood to wall. The provided hardware shall have sufficient strength to carry all anticipated loads including, but not limited to cabling, cable management, equipment and terminating hardware and electronics equipment.
2.3 GROUNDING

A. Comply with requirements in Division 16 Section "Grounding and Bonding" for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:
   1. Connectors: Mechanical type, cast silicon bronze, solderless exothermic-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
   2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide with 9/32-inch holes spaced 1-1/8 inches apart.
   3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with ANSI-J-STD-607-A.

2.4 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 ENTRANCE FACILITIES

A. Contact telecommunications service provider and arrange for installation of demarcation point, protected entrance terminals, and a housing when so directed by service provider.

   1. Install underground entrance pathway complying with Division 16 Section "Raceways and Boxes."

3.2 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

D. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

E. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.
   1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
   2. Record agreements reached in meetings and distribute them to other participants.
   3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
   4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

F. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.3 SLEEVE AND SLEEVE SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 270544 "Sleeves and Sleeve Seals for Communications Pathways and Cabling."

3.4 FIRESTOPPING

A. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."

B. Comply with TIA/EIA-569-A, Annex A, "Firestopping."
C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.5 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with ANSI-J-STD-607-A.

C. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.
   1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.6 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Division 16 Section "Electrical Identification."

B. Comply with requirements in Division 9 Section "Interior Painting" for painting backboards. For fire-resistant plywood, do not paint over manufacturer's label.

C. Labels shall be preprinted or computer-printed type.

3.7 EQUIPMENT RACKS

A. Contractor shall furnish and install wall mounted and floor-mounted equipment racks per manufacturers recommendation.

B. Provide equipment racks of same type, style and finish color as existing, where applicable.

C. Contractor shall permanently install an engraved laminated, phenolic designation plate on each data/telecommunication rack. The plate shall be white with black letters. Helvetica letter heights shall be 3/8".

D. Free standing equipment racks shall be bolted to the floor using anchors in concrete floor and toggle bolts through raised flooring.

E. All racks, cabinets and cable transport hardware shall be bonded to the communications system ground riser.
3.8 BACKBOARDS

A. A minimum of two walls (or as indicated on drawings) shall be covered with plywood backboards to a minimum 8’-6” above finished floor in all Telecommunications spaces and as indicated on Drawings.

B. Securely fasten backboard to wall using appropriate hardware and mount at all four corners, minimum. Securely fasten backboard to wall-framing members (studs).

C. Provide adequate backboard space to allow a clean and workable arrangement for telephone and data connections.

END OF SECTION 16714
1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
B. Related Sections include the following:

1. Division 16 Section “Electrical General Requirements.”

1.2 SUMMARY

A. This Section includes design and installation of a new fire alarm system.

B. Related Sections include the following:

1. Division 8 Section "Door Hardware" for door closers and holders with associated smoke detectors, electric door locks, and release devices that interface with the fire alarm system.

1.3 DEFINITIONS

A. FACP: Fire alarm control panel.

B. LED: Light-emitting diode.

C. NICET: National Institute for Certification in Engineering Technologies.

D. Definitions in NFPA 72 apply to fire alarm terms used in this Section.

1.4 SYSTEM DESCRIPTION

A. Noncoded, analog-addressable system; automatic sensitivity control of certain smoke detectors; and multiplexed signal transmission dedicated to fire alarm service only.

1. Provide additional notification at local fire and police department as required.

A. Fire alarm system shall consist of the following:

1. All new fire alarm control panel, devices, and wiring.
2. System smoke detection above all control panels and notification appliance power supply panels.
3. System smoke detection as required at air handling units, smoke rated transfer openings, and smoke damper locations.
4. System smoke detection in areas identified on plans
5. All flow and tamper switches to monitor fire sprinkler and standpipe systems and report appropriate alarm and supervisory signals.
6. Manual fire alarm boxes at each building exit (prior to entering exit stairwells at each floor).
7. Audible and visual notification appliances in all public and common areas of the building.
8. Emergency Generator Monitoring.
9. Control and monitoring of smoke control systems.

1.5 PERFORMANCE REQUIREMENTS

A. Comply with NFPA 72.

B. A complete functional system meeting the requirements of this specification, including alarm initiating devices and notification appliances at locations and ratings to meet the requirements of the Authorities Having Jurisdiction and all applicable codes shall be provided.

C. Coordinate and avoid conflicts with casework, marker boards, feature walls, and other areas where fire alarm devices would interfere with furnishings, finishes, etc.

D. Fire alarm system vendor shall provide sound pressure level calculations demonstrating compliance with NFPA 72 and establish quantities and tap settings of audible devices.

E. No additional charges for work or equipment required for a code compliant system approved by the Authority Having Jurisdiction will be allowed.

F. Obtain and refer to mechanical drawings for smoke damper locations, smoke rated transfer openings, and air handling equipment CFM’s. Provide smoke detection as required by applicable codes.

G. Premises protection includes A-3 Assembly, and other types of occupancies per architectural drawings.

1. Refer to architectural drawings for complete code analysis including construction type, use groups, special occupancy types, rated walls, smoke barriers and partitions, etc.
H. System functional performance shall be as indicated on the fire alarm matrix on the drawings.

1.6 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Shop Drawings shall be prepared by persons with the following qualifications:
   a. Trained and certified by manufacturer in fire alarm system design.
   b. Fire alarm certified by NICET, minimum Level III.

2. System Operation Description: Detailed description for this Project, including method of operation and supervision of each type of circuit and sequence of operations for manually and automatically initiated system inputs and outputs. Manufacturer's standard descriptions for generic systems are not acceptable.

3. Device Address List: Include address descriptions that will appear on the FACP display.

4. System riser diagram with device addresses, conduit sizes, and cable and wire types and sizes.

5. Wiring Diagrams: Power, signal, and control wiring. Include diagrams for equipment and for system with all terminals and interconnections identified. Show wiring color code.

6. Batteries: Provide battery sizing calculations. Battery size shall be a minimum of 125% of the calculated requirement.

7. Duct Smoke Detectors: Performance parameters and installation details for each detector, verifying that each detector is listed for the complete range of air velocity, temperature, and humidity possible when air-handling system is operating.

8. Floor Plans: Indicate final outlet locations showing address of each addressable device. Show device layout, size and route of cable and conduits.

C. Qualification Data: For Installer.

D. Field quality-control test reports.
E. Operation and Maintenance Data: For fire alarm system to include in emergency, operation, and maintenance manuals. Comply with NFPA 72, Appendix A, recommendations for Owner's manual. Include abbreviated operating instructions for mounting at the FACP.

F. Submittals to Authorities Having Jurisdiction: In addition to distribution requirements for submittals specified in Division 1 Section "Submittals," make an identical submittal to authorities having jurisdiction. To facilitate review, include copies of annotated Contract Drawings as needed to depict component locations. Resubmit if required to make clarifications or revisions to obtain approval. On receipt of comments from authorities having jurisdiction, submit them to Architect for review.

G. Prior to the installation of the fire alarm system, plans shall be submitted and reviewed by "Fire Savvy Consultants" company. A minimum of four (4) sets of complete fire alarm plans and specifications shall be submitted. Two (2) sets will be retained by the Fire Department, and all others will be returned to the fire alarm contractor. The fire alarm system shall be installed and maintained in accordance with NFPA 72 and local ordinances.

H. Documentation:

1. Approval and Acceptance: Provide the "Record of Completion" form according to NFPA 72 to Owner, Architect, and Authorities Having Jurisdiction.
2. Record of Completion Documents: Provide the "Permanent Records" according to NFPA 72 to Owner, Architect, and authorities having jurisdiction. Format of the written sequence of operation shall be the optional input/output matrix.
   a. Hard copies on paper to Owner, Architect, and Authorities Having Jurisdiction.
   b. Electronic media may be provided to Architect.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Lamps for Strobe Units: Quantity equal to 10 percent of amount installed, but not less than 1 unit.
2. Smoke, Fire, and Flame Detectors: Quantity equal to 10 percent of amount of each type installed, but not less than 1 unit of each type.
3. Detector Bases: Quantity equal to 2 percent of amount of each type installed, but not less than 1 unit of each type.
4. Keys and Tools: One extra set for access to locked and tamper-proofed components.
5. Audible and Visual Notification Appliances: One of each type installed.
6. Fuses: Two of each type installed in the system.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. FACP and Equipment:
   a. Honeywell XLS-3000.
   b. Edwards Systems Technology Inc.
   c. NOTIFIER; a Honeywell Company.
   d. Siemens Building Technologies, Inc.; a Cerberus Division.
   e. SimplexGrinnell LP; a Tyco International Company.
   f. Gamewell-FCI; a Honeywell Company.
   g. National Time & Signal.
   h. Xtralis.
2.2 FACP

A. General Description:

1. Modular, power-limited design with electronic modules, UL 864, 9th edition, listed.
2. Addressable initiation devices that communicate device identity and status.
   a. Temperature sensors shall additionally test for and communicate the sensitivity range of the device.
3. Addressable control circuits for operation of mechanical equipment.

B. Alphanumeric Display and System Controls: Arranged for interface between human operator at the FACP and addressable system components including annunciation and supervision. Display alarm, supervisory, and component status messages and the programming and control menu.

1. Annunciator and Display: Liquid-crystal type, 80 characters, minimum.
2. Keypad: Arranged to permit entry and execution of programming, display, and control commands; and to indicate control commands to be entered into the system for control of smoke-detector sensitivity and other parameters.

C. Circuits:

1. Signaling Line Circuits between control panels: NFPA 72, Class A, Style 7
2. Signaling Line Circuits from control panel to devices: NFPA 72, Class A, Style 6.
3. Notification-Appliance Circuits: NFPA 72, Class B, Style Y.
4. Actuation of alarm notification appliances, annunciation, smoke control, and actuation of suppression systems shall occur within 10 seconds after the activation of an initiating device.
5. Electrical monitoring for the integrity of wiring external to the FACP for mechanical equipment shutdown and magnetic door-holding circuits is not required,
provided a break in the circuit will cause doors to close and mechanical equipment to shut down.

D. Smoke-Alarm Verification:

1. Initiate audible and visible indication of an "alarm verification" signal at the FACP.
2. Activate a listed and approved "alarm verification" sequence at the FACP and the detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel FACP indication and system reset if the alarm is not verified.

E. Notification-Appliance Circuit: Operation shall sound in a temporal pattern, complying with ANSI S3.41.

F. Power Supply for Supervision Equipment: Supply for audible and visual equipment for supervision of the ac power shall be from a dedicated dc power supply, and power for the dc component shall be from the ac supply.

G. Alarm Silencing, Trouble, and Supervisory Alarm Reset: Manual reset at the FACP and remote annunciators, after initiating devices are restored to normal.

1. Silencing-switch operation halts alarm operation of notification appliances and activates an "alarm silence" light. Display of identity of the alarm zone or device is retained.
2. Subsequent alarm signals from other devices or zones reactivate notification appliances until silencing switch is operated again.
3. When alarm-initiating devices return to normal and system reset switch is operated, notification appliances operate again until alarm silence switch is reset.

H. Walk Test: A test mode to allow one person to test alarm and supervisory features of initiating devices. Enabling of this mode shall require the entry of a password. The FACP and annunciators shall display a test indication while the test is underway. If testing ceases while in walk-test mode, after a preset delay, the system shall automatically return to normal.
Remote Smoke-Detector Sensitivity Adjustment: Controls shall select specific addressable smoke detectors for adjustment, display their current status and sensitivity settings, and control of changes in those settings. Allow controls to be used to program repetitive, time-scheduled, and automated changes in sensitivity of specific detector groups. Record sensitivity adjustments and sensitivity-adjustment schedule changes in system memory, and make a print-out of the final adjusted values on the system printer.

Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, trouble, and supervisory signals to a remote alarm station through a digital alarm communicator transmitter and telephone lines.

Service Modem: The dial-in port shall allow remote access to the FACP for programming changes and system diagnostic routines. Access by a remote terminal shall be by encrypted password algorithm.

Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signal, supervisory and digital alarm communicator transmitter shall be powered by the 24-V dc source.

1. The alarm current draw of the entire fire alarm system shall not exceed 80 percent of the power-supply module rating.
2. Power supply shall have a dedicated fused safety switch for this connection at the service entrance equipment. Paint the switch box red and identify it with "FIRE ALARM SYSTEM POWER."

Secondary Power: 24-V dc supply system with batteries and automatic battery charger and an automatic transfer switch.


Surge Protection:

1. Install surge protectors recommended by FACP manufacturer. Install on all system wiring external to the building housing the FACP.
O. Instructions: Computer printout or typewritten instruction card mounted behind a plastic or glass cover in a stainless-steel or aluminum frame. Include interpretation and describe appropriate response for displays and signals. Briefly describe the functional operation of the system under normal, alarm, and trouble conditions.

2.3 MANUAL FIRE ALARM BOXES

A. Description: UL 38 listed; finished in red with molded, raised-letter operating instructions in contrasting color. Station shall show visible indication of operation. Mounted on recessed outlet box; if indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type. With integral addressable module, arranged to communicate manual-station status (normal, alarm, or trouble) to the FACP. Double action pull stations shall meet ADA guidelines.

2. Station Reset: Key- or wrench-operated switch.

2.4 SYSTEM SMOKE DETECTORS

A. General Description:

1. UL 268 listed, operating at 24-V dc, nominal.

2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

3. Multipurpose type, containing the following:
   a. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.
   b. Piezoelectric sounder rated at 88 dBA at 10 feet according to UL 464.
   c. Heat sensor, combination rate-of-rise and fixed temperature.

4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection of building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.

6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status.

B. Photoelectric Smoke Detectors:

1. Sensor: LED or infrared light source with matching silicon-cell receiver.

2. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

C. Duct Smoke Detectors:

1. Photoelectric Smoke Detectors:
   a. Sensor: LED or infrared light source with matching silicon-cell receiver.
   b. Detector Sensitivity: Between 2.5 and 3.5 percent/foot smoke obscuration when tested according to UL 268A.

2. UL 268A listed, operating at 24-V dc, nominal.

3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

4. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. The fixed base shall be designed for mounting directly to the air duct. Provide terminals in the fixed base for connection to building wiring.
   a. Weatherproof Duct Housing Enclosure: UL listed for use with the supplied detector. The enclosure shall comply with NEMA 250 requirements for Type 4X.

5. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.

6. Integral Visual-Indicating Light: LED type. Indicating detector has operated and power-on status. Provide remote status and alarm indicator and test station where required.
7. Remote Control: Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at the FACP for calibration, sensitivity, and alarm condition, and individually adjustable for sensitivity from the FACP.

8. Each sensor shall have multiple levels of detection sensitivity.

9. Sampling Tubes: Design and dimensions as recommended by manufacturer for the specific duct size, air velocity, and installation conditions where applied.

10. Relay Fan Shutdown: Provide two (2) sets of contacts rated to interrupt fan motor-control circuit.

2.5 HEAT DETECTORS

A. General: UL 521 listed.

B. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F.


2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to the FACP.

2.6 NOTIFICATION APPLIANCES

A. Description: Equipped for mounting as indicated and with screw terminals for system connections.


2. Finishes:
   a. Wall mounted appliances: Provide red finish with white lettering.
   b. Ceiling Mounted Appliances: Provide white finish.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn.

C. Visible Alarm Devices: Xenon strobe lights listed under UL 1971, with clear or nominal white polycarbonate lens
mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch high letters on the lens.

1. Rated Light Output: 15, 30, 60, 75, 110, 135, 185 candela as required to meet NFPA 72 requirements.
2. Strobe Leads: Factory connected to screw terminals.

2.7 REMOTE STATUS AND ALARM INDICATORS

A. Remote status and alarm indicator and test stations, with LED indicating lights. Light is connected to flash when the associated device is in an alarm or trouble mode. Lamp is flush mounted in a single-gang wall plate. A red, laminated, phenolic-resin identification plate at the indicating light identifies, in engraved white letters, device initiating the signal and room where the smoke detector or valve is located. For water-flow switches, the identification plate also designates protected spaces downstream from the water-flow switch.

2.8 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching door plate.

1. Electromagnet: Requires no more than 3 W to develop 25-lbf holding force.
2. Wall-Mounted Units: Flush mounted, unless otherwise indicated.
3. Rating: 24-V ac or dc.
4. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.9 REMOTE ANNUNCIATOR

A. Description: Duplicate annunciator functions of the FACP for alarm, supervisory, and trouble indications. Also duplicate manual switching functions of the FACP, including acknowledging, silencing, resetting, and testing.


B. Display Type and Functional Performance: Alphanumeric display same as the FACP. Controls with associated LEDs permit acknowledging, silencing, resetting, and testing.
functions for alarm, supervisory, and trouble signals identical to those in the FACP.

2.10 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module listed for use in providing a system address for listed alarm-initiating devices for wired applications with normally open contacts.

2.11 ADDRESSABLE CONTROL MODULE

A. Provide for integration of auxiliary control functions into the analog signaling circuit. Intelligent analog signaling circuit control module shall have the following capabilities:

1. Communication interaction with the analog signaling circuit having the capability of initiating a control function to an auxiliary device based on a specified event.
2. Provide NO/NC contact pairs rated at 2 amps 120 VAC or 24 VDC.

2.12 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Listed and labeled according to UL 632.

B. Functional Performance: Unit receives an alarm, supervisory, or trouble signal from the FACP, and automatically captures one or two telephone lines and dials a preset number for a remote central station. When contact is made with the central station(s), the signal is transmitted. The unit supervises up to two telephone lines. Where supervising 2 lines, if service on either line is interrupted for longer than 45 seconds, the unit initiates a local trouble signal and transmits a signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. When telephone service is restored, unit automatically reports that event to the central station. If service is lost on both telephone lines, the local trouble signal is initiated.

C. Secondary Power: Integral rechargeable battery and automatic charger. Battery capacity is adequate to comply with NFPA 72 requirements.
D. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

2.13 WIRE AND CABLE

A. Wire and cable for fire alarm systems shall be UL listed and labeled as complying with NFPA 70, Article 760.

B. Fire alarm wire and cable shall be as specified by the system manufacturer including conductor gage, conductor quantity, conductor twists and shielding required to meet NFPA class and style performance specified.

C. Signaling Line Circuits and other power limited fire alarm circuits (PLFA):

1. PLFA circuits installed in conduit or raceway: U.L. Listed type FPL
2. PLFA circuit cable installed exposed in accessible ceiling spaces, risers and elsewhere: U.L. Listed type FPLP.
3. PLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Circuit integrity cable, NFPA 70 Article 760, Classification CI, UL listed as Type FPL, FPLR or FPLP as required, and complying with requirements in UL 1424 and in UL 2196 for a 2-hour rating.

D. Non-Power-Limited Fire Alarm Circuits (NPLFA):

1. NPLFA circuits installed in conduit: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation.
   a. Low-Voltage Circuits: No. 16 AWG, minimum.
   b. Line-Voltage Circuits: No. 12 AWG, minimum.
2. NPLFA circuit cable installed exposed in ceiling spaces, risers and elsewhere: Multi-conductor cable, U.L Listed type NPLFP.
3. NPLFA circuits installed where 2 hr rating is required to meet the survivability requirements of NFPA 72: Multi-conductor cable, U.L Listed type NPLFP-CI
PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Smoke or Heat Detector Spacing:
   1. Smooth ceiling spacing shall not exceed 30 feet.
   2. Spacing of heat detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas, shall be determined according to Appendix A in NFPA 72.
   3. Spacing of heat detectors shall be determined based on guidelines and recommendations in NFPA 72.

B. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.

C. Duct Smoke Detectors: Comply with NFPA 72. Install sampling tubes so they extend the full width of the duct.

D. Remote Status and Alarm Indicators: Install near each smoke detector, each duct detector and each sprinkler water-flow switch and valve-tamper switch that is above 10'-0" AFF, concealed, or otherwise not readily visible from normal viewing position. Coordinate exact locations with local fire department and submit to architect for approval.

E. Audible Alarm Notification Appliances: Install wall mounted appliances not less than 6 inches below the ceiling.

F. Visible Alarm Notification Appliances: Install wall mounted appliances at 96" AFF or 6 inches below the ceiling, whichever is less.

G. Coordinate ceiling mounted appliances with reflected ceiling plans. Do not install visual appliances where pendant mounted or suspended lighting fixtures will obstruct intended viewing angles.

H. Install wall mounted and ceiling mounted notification appliances flush on recessed j-box or back box for all new work and on existing gyp-board partition walls.
I. Install notification appliances on existing CMU walls on surface back-boxes matching the dimensions and finish of the notification appliance.

J. Device Location-Indicating Lights: Locate in public space near the device they monitor.

K. FACP: Surface mounted with tops of cabinets not more than 72 inches above the finished floor.

1. Install smoke detector above panel. Install on ceiling for ceilings under 10 ft. For ceilings above 10’, wall mount a smoke detector listed for releasing service 10’ AFF or 1’ below finished ceiling (whichever is lower).

L. Annunciator: Install with top of panel not more than 72 inches above the finished floor.

M. Provide all 120V branch circuits for all control panels, sub panels, and ancillary equipment required for the system.

3.2 WIRING INSTALLATION

A. Install wiring according to the following:

1. NECA 1.
2. TIA/EIA 568-A.

B. Wiring Method:

1. Fire alarm circuits shall consist of multi-conductor cables installed in accessible ceiling spaces.
2. Where ceilings consist of exposed construction, fire alarm multi-conductor cable shall be installed on top of joists, beams etc. and shall be concealed from view. Where the structural elements do not allow for the cable to be installed in a concealed fashion, then install the cable in conduit.
3. Install fire alarm cable in conduit in mechanical rooms, loading docks and similar service spaces.
4. Drops to surface mounted devices shall be installed in conduit or surface raceway. No exposed cable shall be visible below the ceiling. Where the ceiling is exposed, route the conduit or raceway up to the structural member that will conceal the cable.
5. Drops to devices recessed in partition walls shall be installed in conduit.

6. Cables and raceways used for fire alarm circuits, and equipment control wiring associated with the fire alarm system, may not contain any other wire or cable.

7. Signaling Line Circuits: Power-limited fire alarm cables may be installed in the same cable or raceway as signaling line circuits, if the system manufacturer permits it.

C. Wiring within Enclosures: Separate power-limited and non-power-limited conductors as recommended by manufacturer. Install conductors parallel with or at right angles to sides and back of the enclosure. Bundle, lace, and train conductors to terminal points with no excess. Connect conductors that are terminated, spliced, or interrupted in any enclosure associated with the fire alarm system to terminal blocks. Mark each terminal according to the system's wiring diagrams. Make all connections with approved crimp-on terminal spade lugs, pressure-type terminal blocks, or plug connectors.

D. Cable Taps: Use numbered terminal strips in junction, pull, and outlet boxes, cabinets, or equipment enclosures where circuit connections are made.

E. Color-Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color-code for alarm circuit wiring and a different color-code for supervisory circuits. Color-code audible alarm-indicating circuits differently from alarm-initiating circuits. Use different colors for visible alarm-indicating devices. Paint fire alarm system junction boxes and covers red.

F. Risers: Install at least two vertical cable risers to serve the fire alarm system. Separate risers in close proximity to each other with a minimum 1-hour-rated wall, so the loss of one riser does not prevent the receipt or transmission of signals from other floors or zones.

G. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the FACP and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.
3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals according to Division 16 Section "Electrical Identification."

B. Install instructions frame in a location visible from the FACP.

C. Paint power-supply disconnect switch red and label "FIRE ALARM."

3.4 GROUNDING

A. Ground the FACP and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to the FACP.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Before requesting final approval of the installation, submit a written statement using the form for Record of Completion shown in NFPA 72.

2. Perform each electrical test and visual and mechanical inspection listed in NFPA 72. Certify compliance with test parameters. All tests shall be conducted under the direct supervision of a NICET technician certified under the Fire Alarm Systems program at Level III.

3. Visual Inspection: Conduct a visual inspection before any testing. Use as-built drawings and system documentation for the inspection. Identify improperly located, damaged, or nonfunctional equipment, and correct before beginning tests.

4. Testing: Follow procedure and record results complying with requirements in NFPA 72.

   a. Detectors that are outside their marked sensitivity range shall be replaced.
5. Test and Inspection Records: Prepare according to NFPA 72, including demonstration of sequences of operation by using the matrix-style form in Appendix A in NFPA 70.

3.6 PROGRAMMING

A. Coordinate final address descriptions for alarm, supervisory and trouble indication that appear on FACP and Annunciator displays with the Owners representative. This shall include all room names, room numbers, building areas for fire protection zones, exit door descriptions and similar items. This coordination shall take place and be implemented in the programming prior to Demonstration and Owner Training.

3.7 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 Project outside normal occupancy hours for this purpose.

B. Follow-Up Tests and Inspections: After date of Substantial Completion, test the fire alarm system complying with testing and visual inspection requirements in NFPA 72. Perform tests and inspections listed for three monthly, and one quarterly, periods.

3.8 WARRANTY

A. All newly installed equipment shall be warranted by the contractor for a period of one year following acceptance. The warranty shall include parts, labor, prompt field service, pickup and delivery.

3.9 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain the fire alarm system, appliances, and devices. Refer to Division 1.

END OF SECTION 16721
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

B. Related Sections include the following:

1. Division 16 Section “Electrical General Requirements.”
2. Division 16 Section “Conductors and Cables.”
3. Division 16 Section “Grounding and Bonding.”
4. Division 16 Section “Packaged Engine Generators.”
5. Division 16 Section “Enclosed Switches.”
6. Division 16 Section “Transfer Switch.”
7. Division 16 Section “Enclosed Controllers.”
8. Division 16 Section “Surge Protective Devices.”
9. Division 16 Section “Switchboards.”
10. Division 16 Section “Panelboards.”
11. Division 16 Section “Dry Type Transformers (600V and Less).”
12. Division 16 Section “Fuses.”

1.2 SECTION INCLUDES
A. The testing firm shall provide all material, equipment, labor, and technical supervision to perform such tests and inspections.
B. It is the intent of these tests to assure that all tested electrical equipment is operational and within industry and manufacturer's tolerances and is installed in accordance with design Specifications.

C. The test and inspections shall determine suitability for energization.

D. Equipment to be tested and inspected shall be the equipment shown on the one line diagram and schedules as required by part three of each individual Specification Section. In addition, all equipment that is part of an emergency distribution system shall be tested.

1.3 REFERENCES

A. All inspections and tests shall be in accordance with the latest version of the following codes and standards except as provided otherwise herein.

1. National Electrical Manufacturer's Association - NEMA
3. Institute of Electrical and Electronic Engineers - IEEE
7. State and Local Codes and Ordinances
8. Insulated Cable Engineers Association - ICEA
9. Association of Edison Illuminating Companies - AEIC
10. Occupational Safety and Health Administration
11. National Fire Protection Association - NFPA
   a. ANSI/NFPA 70: National Electrical Code
   b. ANSI/NFPA 70B: Electrical Equipment Maintenance
   c. NFPA 70E: Electrical Safety Requirements for Employee Workplaces

1.4 QUALIFICATIONS

A. The testing firm shall be a corporately independent testing organization, which can function as an unbiased testing authority, professionally independent of the
manufacturers, suppliers, and installers of equipment or systems evaluated by the testing firm.

B. The testing firm shall be regularly engaged in the testing of electrical equipment devices, installations, and systems.

C. The lead, on site, technical person and at least 50% of the on site crew shall be currently certified by the InterNational Electrical Testing Association (NETA) or National Institute for Certification in Engineering Technologies in Electrical Power Distribution System Testing.

D. The testing firm shall only utilize technicians who are regularly employed by the firm on a full-time basis for testing services.

E. The Contractor shall submit proof of the above qualifications with bid proposal.

F. The terms used herewithin such as Test Agency, Test Contractor, Testing Laboratory, or Contractor Test Company, shall be construed to mean the testing organization.

G. Acceptable Testing Firms:

1. Northern Electrical Testing; Phone (248) 689-8980.
2. Utilities Instrumentation Services; Phone (734) 482-1450.
3. Emerson/High Voltage Maintenance Corporation; Phone (248) 305-5596.
4. Powertech Services, Inc.; Phone (810) 720-2280.
5. Magna Electric; Phone (248) 667-9492.

1.5 PERFORMANCE REQUIREMENTS

A. The Electrical Contractor shall supply a suitable and stable source of electrical power to each test site. The testing firm shall specify the power requirements.

B. The Electrical Contractor shall notify the testing firm when equipment becomes available for acceptance tests. Work shall be coordinated to expedite project scheduling.
C. The testing firm shall notify the Owner's Representative prior to commencement of any testing.

D. Any system, material or workmanship, which is found defective on the basis of acceptance tests, shall be reported to the Engineer. The Electrical Contractor shall correct all defects.

E. The testing organization shall maintain a written record of all tests and shall assemble and certify a final test report.

F. Safety and Precautions

1. Safety practices shall include, but are not limited to, the following requirements:
   a. Occupational Safety and Health Act.
   c. Applicable state and local safety operating procedures.
   d. NETA Safety/Accident Prevention Program.
   e. Owner's safety practices.
   f. National Fire Protection Association - NFPA 70E.
   g. American National Standards for Personnel Protection.

2. All tests shall be performed with apparatus de-energized except where otherwise specifically required.

3. The testing organization shall have a designated safety representative on the project to supervise operations with respect to safety.

1.6 TEST INSTRUMENT CALIBRATION

A. Test Instrument Calibration

1. The testing firm shall have a calibration program, which assures that all applicable test instruments are maintained within rated accuracy.

2. The accuracy shall be directly traceable to the National Institute of Standards and Technology.

3. Instruments shall be calibrated in accordance with the following frequency schedule:
a. Field instruments: Analog - 6 months maximum  
   Digital - 12 months maximum  
b. Laboratory instruments: 12 months  
c. Leased specialty equipment: 12 months  
   (Where accuracy is guaranteed by Lessor)

4. Dated calibration labels shall be visible on all test equipment.
5. Records must be kept up-to-date which show date and results of instruments calibrated or tested.
6. An up-to-date instrument calibration instruction and procedures shall be maintained for each test instrument.
7. Calibrating standard shall be of higher accuracy than that of the instrument tested.

B. Field Test Instrument Standards

1. All equipment used for testing and calibration procedures shall exhibit the following characteristics:
   a. Maintained in good visual and mechanical condition.
   b. Maintained in safe, operating condition.

C. Suitability of Test Equipment

1. All test equipment shall be in good mechanical and electrical condition.
2. Selection of metering equipment should be based on knowledge of the waveform of the variable being measured. Digital multi-meters may be average of RMS sensing and may include or exclude the dc component. When the variable contains harmonics of dc offset and, in general, any deviation from a pure sine wave, average sensing, average measuring RMS scaled meters may be misleading. Use of RMS measuring meters is recommended.
3. Field test metering used to check power system meter calibration must have any accuracy higher than that of the instrument being checked.
4. Accuracy of metering in test equipment shall be appropriate for the test being performed.
5. Waveshape and frequency of test equipment output waveforms shall be appropriate for the test and tested equipment.
A. A test report shall be generated for each piece of major equipment or groups of equipment and shall include the following:

1. A list of visual and mechanical inspections required by Division 16 Specification Sections in a checklist or similar format.
2. Test reports, including test values where applicable, for all required electrical tests. Clearly indicate where test values fall outside of the limits of recommended values.
3. Summary and interpretation of test results detailing problems located and recommended corrective measures.
4. Record of infrared scan and photos showing potential problem locations.
5. Signed and dated by the testing firm field superintendent stating that all required tests have been completed.

B. Test reports shall be furnished to the Architect/Engineer within 14 days of the completion each test on an ongoing basis. Original copies of the reports shall be furnished directly to the Architect/Engineer by the testing company prior to formal submittal via the Contractors.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

3.1 THERMOGRAPHIC SURVEY

A. Visual and Mechanical Inspection

1. Remove all necessary covers prior to scanning.
2. Inspect for physical, electrical, and mechanical condition.

B. Equipment to be Scanned

1. All components of the distribution system down to and including branch circuit panelboards and motor control centers. Return 3 months after equipment has been energized and loaded to do a final scan of all equipment.
C. Provide report indicating the following:

1. Problem area (location of "hot spot").
2. Temperature rise between "hot spot" and normal or reference area.
3. Cause of heat rise.
4. Phase unbalance, if present.
5. Areas scanned.

D. Test Parameters

1. Scanning distribution system with ability to detect 1°C between subject area and reference at 30°C.
2. Equipment shall detect emitted radiation and convert detected radiation to visual signal.
3. Infrared surveys should be performed during periods of maximum possible loading but not less than twenty percent (20%) of rated load of the electrical equipment being inspected.

E. Test Results

1. Interpretation of temperature gradients requires an experienced technician. Some general guidelines are:
   
a. Temperature gradients of 3°C to 7°C indicate possible deficiency and warrant investigation.
   b. Temperature gradients of 7°C to 15°C indicate deficiency; repair as time permits.
   c. Temperature gradients of 16°C and above indicate major deficiency; repair immediately.

END OF SECTION 16999
SECTION 17010 TELECOMMUNICATIONS GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and General Provisions of the Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to work of this section.

1.2 SUMMARY
A. This Section includes telecommunications general administrative and procedural requirements. The following
requirements are included in this Section to supplement the requirements specified in Division 1 Specification Sections.

1.3 COORDINATION WITH OTHER TRADES

A. The Contractor shall coordinate the installation of the telecommunications wiring devices, equipment, supports, pathways etc., with all other trades prior to installation. Verify and coordinate routing of cable trays, conduits, wireways, etc., intended to support routings of telecommunications cabling.

1.4 DRAWINGS

A. The drawings show the location and general arrangement of equipment, electrical systems and related items. They shall be followed as closely as elements of the construction will permit.

B. Examine the drawings of other trades and verify the conditions governing the work on the job site. Arrange work accordingly, providing such fittings, conduit, junction boxes and accessories as may be required to meet such conditions.

C. Deviations from the drawings, with the exception of minor changes in routing and other such incidental changes that do not affect the functioning or serviceability of the systems, shall not be made without the written approval of the Architect.

D. The architectural and structural drawings take precedence in all matters pertaining to the building structure, mechanical drawings in all matters pertaining to mechanical trades and electrical drawings in all matters pertaining to electrical trades. Where there are conflicts or differences between the drawings for the various trades, report such conflicts or differences to the Architect for resolution.

1.5 INSPECTION OF SITE

A. Visit the site, examine and verify the conditions under which the work must be conducted before submitting proposal.

B. The submitting of a proposal implies that the contractor has visited the site and understands the conditions under which the work must be conducted.
1.6 CONTRACT BREAKDOWN

A. Within two (2) weeks following award of contract, submit to the Architect/Engineer for approval a contract amount breakdown. Breakdown shall be submitted on a form similar to the form available at the Architect's/Engineer's office. All requests for payment shall be based on the approved breakdown.

1.7 TEMPORARY FACILITIES

A. Provide and remove upon completion of the project, in accordance with the general conditions, a complete temporary telephone service during construction, as required.

1.8 ALTERNATES

A. See Alternate Section and other applicable parts of the specifications.

1.9 GUARANTEE

A. Contractor guarantees that the installation is free from defects and agrees to replace or repair, any part of this installation which becomes defective within a period of one year following final acceptance, provided that such failure is due to defects in the equipment, material or installation or to follow the specifications and drawings. File with the Owner any and all guarantees from the equipment manufacturers.

1.10 CODES, PERMITS AND FEES

A. Unless otherwise indicated, all required permits, licenses, inspections, approvals and fees for telecommunications work shall be secured and paid for by the contractor. All work shall conform to all applicable codes, rules and regulations.

B. Rules of local service providers shall be complied with. Check with the local exchange carrier supplying service to the installation and determine all raceways and devices required including, but not limited to, all terminal cabinets, backboards, space requirements, etc.

C. All work shall be executed in accordance with the rules and regulations set forth in local and state codes. Prepare any detailed drawings or diagrams which may be required by the governing authorities. Where the drawings and/or specifications indicate materials or construction in excess
of code requirements, the drawings and/or specifications shall govern.

1.11 STANDARDS OF MATERIAL AND WORKMANSHIP:

A. All materials shall be new. The electrical and physical properties of all materials, and the design, performance characteristics, and methods of construction of all items of equipment, shall be in accordance with the latest issue of the various, applicable Standard Specifications of the following recognized authorities:

A.N.S.I. American National Standards Institute
A.S.T.M. American Society for Testing Materials
BICSI Building Industry Consulting Services International
I.C.E.A. Insulated Cable Engineer’s Association
I.E.E.E. Institute of Electrical and Electronics Engineers
N.E.C. National Electrical Code
N.E.M.A. National Electrical Manufacturer’s Association
TIA/EIA Telecommunications Industry Association/Electronic Industries Association
U.L. Underwriters Laboratories, Inc.

B. Perform all work in a first class and workmanlike manner, in accordance with the latest accepted standards and practices for the Trades involved.

C. All equipment of the same or similar systems shall be by the same manufacturer.

1.12 RECORD DRAWINGS

A. Provide complete operating and maintenance instruction manuals covering all telecommunications equipment herein specified, together with parts lists. All literature shall be furnished in triplicate for Owner and shall be bound in book or ring binder form as directed by Architect/Engineer.

B. The operating and maintenance instructions shall include a brief, general description for all electrical systems including, but not limited to:
1. Routine maintenance procedures.
2. Trouble-shooting procedures.
3. Contractor's telephone numbers for warranty repair service.
4. Shop drawings.
5. Recommended spare parts lists.
6. Names and telephone numbers of major material suppliers.

C. Provide revised telecommunications working drawings indicating "as-built" conditions. Drawings shall indicate all changes that have occurred during construction. Properly identify backbone and horizontal wiring pathways. Locate all network and workstation devices. Identify all devices on plan with proper labeling. "As-Built" drawings shall be submitted on AutoCAD 2010 or compatible electronic format.

1.13 MATERIAL AND EQUIPMENT MANUFACTURERS

A. All items of equipment shall be furnished complete with all accessories normally supplied with the catalog items listed and all other accessories necessary for a complete and satisfactory operating system. All equipment and materials shall be new and shall be standard products of manufacturers regularly engaged in the production of telecommunications equipment and shall be of the manufacturer's latest design.

B. Any equipment offered as a substitution shall be equal in quality, durability, appearance, and performance through all ranges of operation, shall conform with arrangements and space limitations of the equipment shown on the plans and/or specified, shall be compatible with the other components of the system. All costs to make these items of equipment comply with these requirements including, but not limited to, conduit, wiring, enclosures and building alterations shall be included in the original bid. Similar equipment shall be by one manufacturer.

1.14 USE OF EQUIPMENT

A. The use of any equipment or any part thereof for purposes other than testing even with the Owner's consent shall not be construed to be an acceptance of the work on the part of the Owner, nor be construed to obligate the Owner in any way to accept improper work or defective materials.
1.15 WORK PROVIDED BY OTHERS

A. Conduit, cabletrays, sleeves, boxes, floor boxes, surface raceways and grounding shall be provided by the Electrical Contractor under Division 26.

B. Coordinate installation of telecommunications work with work provided by Electrical Contractor in paragraph A above.

C. The Owner will provide system cabling, connectors, coverplates, rack, patch panels, etc., network electronics equipment in all Communication Rooms and all voice cross-connect jumpers and voice/data patch cords as required.

PART 2 - PRODUCTS (not applicable)

PART 3 - EXECUTION

3.1 INSTALLATION OF EQUIPMENT

A. Install all equipment in strict accordance with all directions and recommendations furnished by the manufacturer. Where such directions are in conflict with the drawings and specifications, report such conflicts to the Architect/Engineer for resolution.

3.2 WORK IN EXISTING BUILDINGS

A. The Owner will provide access to existing buildings as required. However, this contractor, once work is started in the existing building, shall complete same without interruption so as to return work areas as soon as possible to Owner.

B. Adequately protect and preserve all existing and newly installed work. Promptly repair any damage to same at this contractor's expense.

C. Consult with the Owner's representative as to the methods of carrying on the work so as not to interfere with the Owner's operation any more than absolutely necessary. Accordingly, all telecommunications services shall be kept in operation as long as possible and the services shall only be interrupted at such time as will be designated by the Owner's representative.

3.3 COORDINATION

A. Install work to avoid interference with work of other trades including, but not limited to, architectural, mechanical and
electrical trades. Remove and relocate any work that causes interference at this contractor's expense. Disputes regarding the cause of interference will be resolved by the Owner's representative or Architect/Engineer.

3.4 CHASES AND RECESSES

A. Chases and recesses shall be provided by the Architectural Trades, but this contractor shall be responsible for coordinating their accurate location and size.

3.5 SLEEVES

A. Provide and install rigid steel conduit sleeves cut to length wherever conduits or cabling pass through floors or cables pass through openings in walls.

B. All sleeves through the floor are to extend 2 inches above floor, unless otherwise noted. Provide escutcheons at each sleeve in finished areas and adequate spacing between sleeves to accommodate escutcheons.

3.6 CUTTING, PATCHING AND DAMAGE TO OTHER WORK

A. Refer to General Conditions for requirements.

B. All cutting, patching and repair work shall be performed by the contractor through approved, qualified subcontractors. Contractor shall include full cost of same in bid.

3.7 EXCAVATION AND BACKFILLING

A. Provide all excavation, trenching, tunneling, dewatering and backfilling required for the telecommunications work. Coordinate the work with other excavating and backfilling in the same area.

B. Where conduit is installed less than 2'6" below the surface of pavement, provide concrete encasement, 4" minimum coverage, all around or as shown on the electrical drawings.

C. Backfill all excavations inside building, under drives and parking areas with well-tamped granular material. Granular backfill shall be placed in layers not more than 8 inches in thickness, 95 percent compaction throughout with approved compaction equipment. Tamp, roll as required. Excavated material shall not be used.

D. Backfill outside building with granular material to a height 12 inches over top of pipe compacted to 95 percent compaction.
as specified above. Backfill remainder of excavation with unfrozen, excavated material in such a way to prevent settling.

3.8 ACCESS DOORS

A. Provide access doors for installation by architectural trades. In the walls, provide Milcor No. "DW" or "M" as required to make all controls, electrical boxes and other equipment installed by the contractor accessible. Minimum size 12 inches x 12 inches. In the ceiling, provide Milcor No. 3210, 3105 or 3206 for accessibility as mentioned above, 24 inches x 24 inches minimum size. The plaster or acoustical tile insert shall be by the architectural trades. Areas with accessible ceilings (ceilings where tiles are not fastened in place and can be individually removed without removal of adjacent tiles) will not require access doors.

B. When access doors are in fire resistant wall or ceilings, they must bear the Underwriters Laboratories, Inc., Label, with time design rating equal to or exceeding that of the wall or ceiling unless they were a part of the tested assembly.

3.9 CLEANING

A. All debris shall be removed daily as required to maintain the work area in a neat, orderly condition.

B. Final cleanup shall include, but not be limited to, cleaning all telecommunications equipment spaces, devices, cover plates, and removing all scrap cable and debris from pathways.

3.10 PROTECTION AND HANDLING OF EQUIPMENT AND MATERIALS

A. Equipment and materials shall be protected from theft, injury or damage.

B. Protect conduit openings with temporary plugs or caps.

C. Provide adequate storage for all equipment and materials delivered to the job site. Location of the space will be designated by the Owner's representative or Architect. Equipment set in place in unprotected areas must be provided with temporary protection.
3.11 EXTRA WORK

A. For any extra telecommunications work that may be proposed, this contractor shall furnish to the General Contractor, an itemized breakdown of the estimated cost of the materials and labor required to complete this work. This contractor shall proceed only after receiving a written order from the General Contractor establishing the agreed price and describing the work to be done.

3.12 DRAWINGS AND MEASUREMENTS

A. These Specifications and accompanying drawings are intended to describe and provide for finished work. They are intended to be cooperative, and what is called for by either shall be as binding as if call for by both. The Contractor will understand that the work herein described shall be complete in every detail.

B. The drawings are not intended to be scaled for rough-in measurements or to serve as Shop Drawings. Field measurements, necessary for ordering materials and fitting the installation to the building construction and arrangement, shall be taken by this contractor.

END OF SECTION 17010