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1.1 GENERAL

A. The Owner of this Project is:

Northwest Florida State College
1000 College Boulevard
Niceville, Florida 32578

B. The Architect for this Project is:

Goodwyn Mills Cawood
720 Bayfront Parkway, Suite 200
Pensacola, FL 32502
Tel: (850) 432-0706 ext. 104
Contact: Steve Jernigan, FAIA
steve.jernigan@gmcnetwork.com

C. General Contractors are invited to submit a Bid for the construction of renovations and additions at the Defuniak Springs Campus.

D. The Work of this project is generally described as interior renovations to Buildings 500 and 501, a covered walkway between Buildings 500 and 501, a new Welding/Trades Building and a new Drone Facility.

E. Bids must be on a stipulated sum basis.

F. The Owner will receive sealed Bids until 2 PM local time, January 20, 2020 at the office of the Department of Purchasing on the Niceville Campus of Northwest Florida State College, Building 310.

G. Bidders are required to submit Document 00 4300 - Bid Form Supplements within 24 hours after the time set for receipt of Bids.

H. Bids will be opened publicly immediately after the time set for submittal.

I. Bidders are required to state the number of days required to achieve Substantial Completion of the Work. Consideration will be given to the stated time of completion when reviewing Bids submitted.

J. A Bid Security [in the amount of 5 percent of the highest possible Bid amount is required.

K. Bids are required to be submitted under a condition of irrevocability for a period of 60 days after submittal.

L. Submit Bids on the Bid Form provided.

M. Not later than 7 days prior to the date of Bid submittal, Bidders shall submit an executed copy of AIA Document A305, Contractor's Qualification Statement, latest edition.

N. Refer to Document 00 2113 - Instructions to Bidders for additional information.

1.2 BIDDING DOCUMENTS

A. Bidding Documents will be distributed via electronic media from [the office of the Owner free of charge.
B. Bidding Documents will not be issued directly to sub-bidders.

C. Bidding Documents may be examined at the office of the Owner at the address listed above.

1.3 EXAMINATION OF SITE AND PRE-BID CONFERENCE

A. An examination of the site has been arranged for Bidders and sub-bidders on January 7, 2020 at 10:00 AM.

B. Representatives of the Owner and Architect will be in attendance.

END OF DOCUMENT
DOCUMENT 002113

INSTRUCTIONS TO BIDDERS

1.1 DOCUMENT

A. American Institute of Architects Document A701-2007, Instructions to Bidders, forms a part of the Bidding Documents and by reference is incorporated herein as fully as if repeated at length.

1.2 RELATED REQUIREMENTS

A. Document 001113 - Advertisement for Bids
B. Request for Proposals and Required Forms
C. ATC Remediation Report
D. Pre-Construction Risk Assessment

1.3 SUPPLEMENTS

A. The following supplements modify, delete from, or add to the Instructions to Bidders referenced above.
B. Where provisions of the Instructions to Bidders are modified, unaltered provisions remain in effect.
C. Article 3 - Bidding Documents:
   1. In Subparagraph 3.2.2, change “seven days” to read “three days.”
   2. Delete Subparagraph 3.3.2; substitute the following:

              3.3.2 Substitutions will not be considered prior to award of Contract. Refer to Section 016000 - Product Requirements for additional information.

   3. Delete Subparagraphs 3.3.3 and 3.3.4.
D. Article 4 - Bidding Procedures:
   1. Add Subparagraph 4.1.8:

              4.1.8 Identify the time of completion on the Bid Form. The date of Substantial Completion in the Owner/Contractor Agreement shall be the time of completion added to the commencement date.

   2. Delete the first sentence of Subparagraph 4.2.1; substitute the following:

              4.2.1 Each Bid shall be accompanied by a Bid Security in an amount equal to 5 percent of the maximum possible Bid amount, consisting of either a certified check or a surety bond, pledging that the Bidder will enter into a contract with the Owner on the terms stated in the Bid [and will furnish bonds covering the faithful performance of the contract and payment of obligations arising thereunder.

   3. Delete Subparagraph 4.2.2; substitute the following:

              4.2.2 If a surety bond is submitted, it shall be issued by a surety licensed to conduct business in the State in which the project is located, and shall be written on American Institute of Architects (AIA) Document A310, Bid Bond. The attorney-in-fact who executes the bond on behalf of the surety shall affix to the bond a certified and current copy of the power of attorney.
E. Article 5 - Consideration of Bids:

1. Add the following to Subparagraph 5.2.1:

   5.2.1 The Owner shall have the right to disqualify any Bidder who fails to satisfy the Owner that he is qualified to complete the Work.

2. Add Subparagraph 5.3.3:

   5.3.3 The Owner requires that work of this contract be completed as quickly as possible. Consideration will be given to the time of completion when reviewing the Bids submitted.

F. Article 8 - Form of Agreement Between Owner and Contractor: The Agreement for the Work will be written on AIA Document A101 - Standard Form of Agreement Between Owner and Contractor where the basis of payment is a Stipulated Sum.

END OF DOCUMENT
1.1 INVESTIGATION

A. Geotechnical investigations were conducted at the site, the results of which can be found in the report issued by Goodwyn, Mills & Cawood, Inc..

B. A copy of the report is bound into the Project Manual.

1.2 INTERPRETATION

A. The report is provided only for bidder's information and convenience and is not part of the Contract Documents. Owner and Architect do not warrant the accuracy or extent of the report or locations of the test borings.

B. Opinions expressed in the report are those of the Geotechnical Engineer and represent the Geotechnical Engineer's interpretation of subsoil conditions, tests, and results of analyses that the Geotechnical Engineer has conducted.

C. The report is based upon the assumption that uniform variation exists in soil properties between borings. Interpretation of the report is bidder's responsibility. Owner and Architect will not be responsible for interpretation of report by bidders.

D. Bidders are urged to examine the report and the site.

E. Additional soil borings or other exploratory operations may be made by bidders at no additional cost to Owner, provided such operations are approved by Owner in advance.

F. Refer to Conditions of the Contract for additional information.

END OF DOCUMENT
Northwest Florida State College
Walton Works Report

DEFUNIAK SPRINGS, WALTON COUNTY, FLORIDA

December 17, 2019

REPORT OF GEOTECHNICAL EXPLORATION

Prepared By

Goodwyn, Mills and Cawood, Inc.
720 Bayfront Pkwy. Suite 200
Pensacola, FL 32502
T 850.432.0706
www.gmcnetwork.com

GMC PROJECT NUMBER: GPN190001
December 17, 2019

Mr. Steve Jernigan, FAIA  
Goodwyn Mills & Cawood  
720 Bayfront Pkwy, Suite 200  
Pensacola, FL. 32502

RE: REPORT OF GEOTECHNICAL EXPLORATION  
WALTON WORKS SITE  
NORTHWEST FLORIDA STATE COLLEGE  
DEFUNIAK SPRINGS, WALTON COUNTY, FLORIDA  
GMC PROJECT GOPEN190001

Dear Mr. Jernigan:

Goodwyn, Mills and Cawood, Inc. (Geotechnical & Construction Services Division) is pleased to provide this report of geotechnical exploration performed for the above referenced project. This report includes the results of the field and laboratory testing and recommendations for foundation design, site preparation, and pavements.

We appreciate the opportunity to perform this study on this phase of the project for you and look forward to continued participation during the construction phase of this project. If you have any questions pertaining to this report, or if we may be of further service, please do not hesitate to call.

Sincerely,

GOODWYN, MILLS AND CAWOOD, INC.

[Signature]

Kevin W. Wales,  
Executive Vice President
1.0 PROJECT INFORMATION AND SCOPE OF WORK

1.1 Project Information

A geotechnical exploration and evaluation have been conducted for the new Walton Works site located on US Highway 90 on the undeveloped parcel west of Northwest Florida State College Chautauqua Center. The proposed construction will consist of a one-story metal framed building, associated parking, and a retention pond. The existing site is currently undeveloped with sparse trees and trials throughout.

We have been provided with a proposed site layout showing the proposed Welding Building and Drone Building structures and the pond location. The proposed retention pond will have a top elevation of EL 234 feet and a bottom elevation of EL 229 feet. The Welding Building will be approximately 7,048 SF with an FFE of EL 244.5 feet. The Drone Building will be approximately 915 SF with an FFE of EL 245 feet. Based on the current grades, the Welding Building will require up to 4 feet of fill and 2 feet of cut to achieve the required grade, and the Drone Building will require about 2 feet of cut. We understand the maximum column load (DL + LL) is 25 kips.

1.2 Scope of Work

The purpose of this exploration was to perform a general evaluation of the subsurface soil conditions at the site and to provide general sitework, pavement, and foundation recommendations. The scope of the exploration and evaluation included drilling a total of six (6) soil test borings; two borings (B-1 and B-2) were drilled in the proposed building footprints, two borings (SB-1 and SB-2) in the proposed retention pond location, one (B-3) in the proposed pavement area, and one (SB-3) in an alternate pond location.

The scope of services for the geotechnical study did not include any environmental assessment for the presence or absence of wetlands or hazardous or toxic materials in the soil, surface water, groundwater, or air, on or below or around this site.

2.0 FIELD EXPLORATION AND LABORATORY TESTING

2.1 Field Exploration

The boring locations and depths were selected by GMC personnel. Field-testing employed by GMC was performed in general accordance with ASTM standards or generally accepted methods. The borings were located by in the field by GMC survey personnel.

The borings were performed using a Simco 2800 drill rig equipped with a rotary head and solid flight augers (SFA). Soils were sampled using a two-inch OD split barrel sampler in general accordance with ASTM D1586 driven with a manual hammer.

2.2 Laboratory Analyses

The laboratory-testing program included visual classification of all soil samples and laboratory tests consisting of natural moisture contents, grain size analysis, and falling head permeability tests (on remolded samples). The
laboratory testing program was conducted in general accordance with applicable ASTM standards and the results are indicated on the Boring Records and summarized in the Appendix.

3.0 SITE AND SUBSURFACE CONDITIONS

3.1 General

At the time of this study, the proposed site was mainly wooded with light underbrush and some grassed areas on the southern portion where the proposed buildings will be located. The site slopes from southeast to northwest, with an elevation high of EL 247 feet to a low of about EL 226 feet in the wetlands area. Site photographs are included in the Appendix.

3.2 Site Geology

Published geologic information indicates the site is underlain by the Citronelle Formation of the Pliocene Series. The Citronelle Formation consists of gray to orange, often mottled, unconsolidated to poorly consolidated, very fine to very coarse, poorly sorted, clean to clayey sands. It contains significant amounts of clay, silt and gravel which may occur as beds and lenses and may vary considerably over short distances. Limonite nodules and limonite-cemented beds are common. Much of the Citronelle Formation is highly permeable. It forms the Sand and Gravel Aquifer of the surficial aquifer system.

3.3 Subsurface Conditions

The subsurface conditions generally consisted of very loose to medium poorly graded fine sands (USCS classification SP) and loose to dense clayey and silty sand (SC and SM). A zone of sandy fat clay (CH) was present in boring B-2 at a depth of 13 to 17 feet. In boring B-1, the upper 6 feet consisted of very loose to loose sand, with Standard Penetration Test (SPT) N-values ranging from 3 to 8 blows per foot (bpf). In boring B-3, the SPT values ranged from 2 to 5 bpf to the termination depth of 6 feet.

Highly plastic clays (CH) have the potential of shrinking and swelling with a corresponding loss or gain in soil moisture. However, based on the depth at which these soils were encountered, they should not impact foundation performance.

The subsurface descriptions contained herein are of a generalized nature to highlight the major soil stratification features and soil characteristics. The boring records included in the Appendix should be reviewed for specific information as to individual boring locations. The stratification shown on the boring records represents conditions only at the actual boring locations. Variations may occur and should be expected between boring locations. The stratifications represent the approximate boundary between subsurface materials, and the transition may be gradual.

3.4 Groundwater Information

Groundwater was encountered in the borings at the time of drilling. The depths recorded are the depths at the time of our exploration. Groundwater may not have had time to sufficiently stabilize due to the brevity of the fieldwork. The following table summarizes the groundwater levels encountered:

<table>
<thead>
<tr>
<th>Boring Number</th>
<th>Groundwater Depth Below Existing Grade (Feet)</th>
<th>Groundwater Elevation Below Existing Grade (Feet)</th>
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<tbody>
<tr>
<td>B-1</td>
<td>18</td>
<td>229</td>
</tr>
<tr>
<td>B-2</td>
<td>17</td>
<td>224</td>
</tr>
<tr>
<td>B-3</td>
<td>Not encountered</td>
<td>---</td>
</tr>
<tr>
<td>SB-1</td>
<td>13</td>
<td>226</td>
</tr>
<tr>
<td>SB-2</td>
<td>9.5</td>
<td>225.5</td>
</tr>
<tr>
<td>SB-3</td>
<td>14</td>
<td>228</td>
</tr>
</tbody>
</table>

Groundwater in the region generally occurs as an unconfined aquifer condition. Recharge is usually provided by the infiltration of rainfall and surface water through the soil overburden. More permeable zones in the soil can affect groundwater conditions. The groundwater table is likely to follow the surface topography. Based on a review of topographic map and our visual site observations, we anticipate the groundwater flow at the site to be towards the north and the wetlands area.

Groundwater levels vary with changes in season and rainfall, construction activity, surface water runoff and other site-specific factors. Based on historical rainfall data in this area, groundwater levels would typically be...
the lowest in the late fall to winter and highest in the early spring to mid-summer with annual groundwater fluctuations by seasonal rainfall.

3.5 Hydraulic Conductivity

Our field exploration at the subject site included performing two (2), 15-foot deep Standard Penetration Test borings within the proposed retention basin footprint. Drilling, testing and sampling operations were performed in general accordance with ASTM designations and other industry standards. The groundwater elevations recorded in the borings were at 13 and 9.5 feet below existing grade, corresponding to an elevation of about EL 226 feet. The borings were drilled during a period of relatively normal seasonal rainfall and within a pattern of frequent rain events. At this depth, the soils consisted of very loose to dense sand and sand with clay (USCS classification of SP and SP-SC). A combined sample of this material sampled from about EL 229 to EL 226 was remolded and a falling head permeability test was performed. As an alternate, a sample from boring SB-3 was also tested about this same elevation. The results are summarized below:

<table>
<thead>
<tr>
<th>Location</th>
<th>Depth/Elevation (feet)</th>
<th>Percent Fines (#200)</th>
<th>Moisture Content (%)</th>
<th>Dry Unit Weight of Remolded Sample (pcf)</th>
<th>Hydraulic Conductivity, K, (ft/day)</th>
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</thead>
<tbody>
<tr>
<td>SB-1 and SB-2</td>
<td>11-13’ / 229-227’ (SB-1) 6-9’ / 229-226’ (SB-2)</td>
<td>12.9%</td>
<td>8.6</td>
<td>130.1</td>
<td>1.9</td>
</tr>
<tr>
<td>SB-3</td>
<td>13-16’ / 229-226’</td>
<td>11.4</td>
<td>18.7</td>
<td>107.9</td>
<td>0.01</td>
</tr>
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</table>

Based on the lab results of the soils and additional review of past water levels of the adjacent wetland, we recommend a seasonal high groundwater (SHGW) elevation to be approximately EL 228.5 feet.

The provided seasonal high groundwater level estimates are based on the soil strata encountered in our borings, the groundwater levels measured at the site; and published historical rainfall data. Please note that the measured hydraulic conductivity rates and corresponding calculated infiltration rates could be adversely impacted if siltation of the pond bottom is allowed after construction.

4.0 CONCLUSIONS AND RECOMMENDATIONS

4.1 General Considerations

Based on the information provided to us and the data collected during the subsurface exploration, the site should be suitable for the proposed construction provided the site is prepared as provided herein. There are several geotechnical related considerations that will likely affect the proposed construction and the following summarizes those considerations and our recommendations:
• Surface organic laden material (OLM) should be stripped from the planned building and pavement areas.
• Once the building and parking areas are cut to grade, the surface soils should be densified with a smooth drum roller. The soils with SPT N-values between 2 and 8 bpf may be present at the planned subgrade elevations and will require densification (compaction) prior to the placement of any new fill or foundation construction. The soils removed, or cut, should be suitable for reuse as fill if the organics are less than 5 percent by weight.
• Conventional shallow foundations bearing in the newly compacted fill or medium sands should be sized for a net allowable bearing capacity of 2,000 pounds per square foot (psf) bearing a minimum of 18 inches below exterior grade. Fill material placed in the building area and 5 feet beyond the building perimeter and in the upper 12 inches beneath pavements should be compacted to at least 95 percent of the modified Proctor (ASTM D1557) maximum dry density.
• Pavement subgrades should be prepared in the same manner as the building area and the upper 12 inches of soil beneath the pavements should be compacted to at least 98 percent of the modified Proctor (ASTM D1557, AASHTO T180) maximum dry density and shall consist of stabilized subgrade.

The following sections contain recommendations relative to geotechnical considerations for site work, foundation design, and pavements.

4.2 Sitework

Sitework should begin with clearing and grubbing (stripping) and should include the removal of the organic laden material (OLM), root zones, and existing pavements in the proposed construction controlled areas. A minimum of 6 inches of OLM should be budgeted to be removed across the developed areas and should include the removal of the root balls of the existing trees in the wooded areas.

We recommend densifying (compacting) the upper zone of sands (SP, N-values of concern between 2 and 8) that were encountered in the upper 6 feet. This can most likely be accomplished by compacting the exposed subgrade from the stripped grade elevation with a heavy weight vibratory roller (i.e., a minimum 10-ton roller, static weight, with a minimum 5-foot drum diameter), as equipment of this size can typically impact sandy profiles to depths of 5+ feet. We note that vibratory compaction operations should not be performed within a clear distance of 50 feet from any adjacent structures. Verification of the improvement of the loose subgrade soils to a depth of 4 feet below the stripped grade elevation should be achieved via Dynamic Cone Penetrometer testing. Additional recommendations (i.e., further compaction effort, possible undercutting, etc.) can be rendered in the field as these tests are performed.

Typically, due to the movement of heavy equipment and weather conditions, the subgrade becomes disturbed during construction. As a result, fine grained (clayey and silty) soils have a tendency to lose shear strength and support capability. Therefore, additional effort on the Contractor’s part will be required to reduce traffic and limit disturbance of soils. It is essential that the subgrade be restored to a properly compacted condition based on optimum moisture and density requirements. Restoration of the subgrade should be addressed in the project specifications.
We recommend a GMC geotechnical engineer or qualified soils' technician observe the site preparation operations.

4.3 Time of Year Site Preparation Considerations

During periods of heavy rain, the near surface soils can become saturated and swampy conditions can occur. The time of the year that the sitework begins can affect the project considerably. There are many considerations that need to be addressed prior to bidding a project that could affect the budget based on the time of year a project starts earthwork activities. The time of the year that the geotechnical borings were performed can provide a false sense of actual near surface conditions depending on the time of year and weather conditions. Below are considerations that should be addressed based on the time of the year earthwork is started.

“Wet” Season
During the wet season, the amount of undercutting may be greater, therefore resulting in greater excavation costs. The soils are typically proofrolled to determine their suitability for the placement of new fill or subgrade support. During the wet season, the surface soils have a higher moisture content and will tend to pump, therefore, hindering the placement of new fill. In addition, the drying time, time period between rain events, and temperature is not conducive to scarify soils, allow to dry, and recompact. At this time, the decision should be made by the owner to try either scarify/dry/compact the in-place soils, which could take time, or undercut and replace with suitable material, which could increase the sitework costs. Based on our experience, the amount of undercut could be an additional 1 to 2 feet (or greater in localized areas), whereas in drier weather, lesser amounts of undercutting may be necessary, if recompaction or stabilization of soils left in place can be achieved.

Some undercut soils are not always “unsuitable” soil and can be moisture conditioned and reused as fill in the deep areas, if drying conditions are favorable.

“Dry” Season
During the dry season, the surface soils have a lower moisture content and will tend to “bridge” or “crust” softer underlying soils. They will generally allow the placement of new fill, but the crust can break down if repeated passes with heavily loaded equipment is persistent. In addition, new fill from cuts or other sources may need to be moisture conditioned prior to compaction. The soils can dry significantly, requiring the addition of water for proper compaction. Water trucks should be used, as necessary, by the contractor to condition the soils within the required specifications.

Contractor Responsibility
The grading contractors have the option of performing their own evaluation of the site conditions to assess the excavation considerations based on the time of year a project is bid. We strongly suggest that the grading contractors conduct their own exploration and evaluation of the site conditions and material management requirements to cost effectively develop the site.
4.4 Excavation Characteristics of On-Site Materials

Soils encountered by the borings should be removable with conventional earthmoving equipment. Any material loosened below foundation locations should be removed or recompacted prior to foundation construction.

4.5 Fill Placement

Soil Fill Material

Soil fill material in the building and parking area should be placed in loose lifts not exceeding 8-inches in thickness with a maximum particle size of 3 inches. In confined areas, portable compaction equipment and thinner fill lifts (4-6 inches) may be necessary. The following table summarizes the compacted fill requirements:

<table>
<thead>
<tr>
<th>Location</th>
<th>Test Method</th>
<th>Compaction Required (minimum)</th>
<th>Moisture Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>Structural Area and 5’ beyond perimeter</td>
<td>ASTM D1557 (modified)</td>
<td>95%</td>
<td>+/-3 percentage points of optimum moisture</td>
</tr>
<tr>
<td>Below pavement base material</td>
<td>ASTM D1557/ AASHTO T180</td>
<td>Upper 12 inches - 98%</td>
<td>Below 12 inches – 95%</td>
</tr>
<tr>
<td></td>
<td>(modified)</td>
<td></td>
<td>+/-3 percentage points of optimum moisture</td>
</tr>
</tbody>
</table>

Off-site borrow fill material should meet the following characteristics:

<table>
<thead>
<tr>
<th>Property</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Organic Material</td>
<td>$\leq 5%$</td>
</tr>
<tr>
<td>Liquid Limit</td>
<td>$\leq 50%$</td>
</tr>
<tr>
<td>Plasticity Index</td>
<td>$\leq 25%$</td>
</tr>
<tr>
<td>Maximum Dry Density</td>
<td>$\geq 95$ lb/ft$^3$</td>
</tr>
<tr>
<td>Maximum Particle Size</td>
<td>3 inches or less</td>
</tr>
</tbody>
</table>

Samples of the proposed fill materials should be provided to the geotechnical engineer for Proctor testing and evaluation prior to placement. Density tests should be performed to document compaction and moisture content of any earthwork involving soils and other applicable materials.

4.6 Backfilling of Utility Trenches

Backfilling of storm drain and utility trenches must be performed in a controlled manner to reduce settlement of the fill and cracking of overlying floor slabs and pavements. We recommend that utility trenches be backfilled with acceptable borrow or dense-graded crushed stone in 4 to 6-inch loose lifts compacted with mechanical piston tampers to the project requirements.
4.7 Subgrade Restoration

Typically, due to the movement of heavy equipment and weather conditions, the subgrade soil becomes disturbed during construction. As a result, these soils have a tendency to lose shear strength and support capability. Therefore, additional effort on the contractor’s part will be required to reduce traffic and limit disturbance of soils. It is essential that the subgrade be restored to a properly compacted condition based on optimum moisture and density.

4.8 Shallow Foundations

After the site is prepared as recommended, conventional shallow foundations bearing in the newly compacted fill (95% modified Proctor) or medium sands should be sized for a net allowable bearing capacity of 2,000 pounds per square foot (psf) bearing a minimum of 18 inches below exterior grade. Based on the assumed loads and type of structures, we estimate that the total settlements should be less than 1-inch for foundations bearing in the material as described above, with differential settlements on the order of ½-inch.

Even though computed footing dimensions may be less, column footings and continuous footings should have minimum width dimensions of 24 inches and 18 inches, respectively. This allows for hand cleaning of materials disturbed during the excavation process and reduces the potential for punching shear failure.

Foundation excavations should be checked by a geotechnical professional once excavated to the required bearing depth to verify the design bearing pressure is available. If not, the footing excavation should be extended to suitable bearing soils. The engineer can provide geotechnical guidance to the owner’s design team should any unforeseen foundation problems develop during construction. If any areas of foundation surfaces prove to be unsuitable, the foundation excavation should be over-excavated. The over-excavated area can be backfilled with “lean” concrete (1,500 psi) or compacted crushed stone up to the planned foundation bearing depth.

Foundation concrete should be placed the same day as soon as possible so that the foundation bearing soils can remain near the existing moisture content. Foundation bearing surfaces should not be disturbed or left exposed during inclement weather. Saturation of the on-site soils can cause a loss of strength and increased compressibility. Excavations for footings should be hand cleaned to remove any loose soil or mud from the foundation bearing surface. If construction occurs during inclement weather and concreting is not possible immediately after excavation, we recommend that a thin layer (approximately 2 inches) of lean concrete or flowable fill be placed on the bearing surface for protection after we have observed and evaluated the exposed bearing surfaces. Exposed bearing soils should be compacted prior to placement of reinforcing.

4.9 Floor Slabs

The conditions exposed at subgrade levels will vary across the site and may include structural fill. The slab-on-grade may be adequately supported on these subgrade conditions subject to the recommendations in this report. The slab-on-grade should be jointed around columns and along walls to reduce cracking due to differential movement. An underdrain system is not necessary beneath the slab, provided that the slab is
established at least 2 feet above the normal permanent SHGW table. An impermeable vapor barrier is recommended beneath finished spaces to reduce dampness.

Care should be taken so that fines from the subgrade are not allowed to contaminate the granular layer. If fines do contaminate this layer, capillary rise and subsequent damage to moisture sensitive floor coverings could occur. On most projects, there is some time lag between initial grading and the time when the contractor is ready to place concrete for the slab-on-grade. Inclement weather just prior to placement of concrete for the slab-on-grade can result in trapped water in the granular layer.

5.0 PAVEMENTS

5.1 General

No traffic information has been provided however, we assume that typical traffic will include automobiles and occasional trucks. If this traffic information changes, it should be provided to us so that we can review the pavement recommendations and make any necessary changes to the pavement sections. Based on the existing site conditions and planned use, we recommend that a flexible pavement be utilized. If a rigid pavement design is requested, we can provide that in an addendum.

5.2 Subgrade

Prior to base course or fill placement, we recommend that the pavement subgrade be proofrolled with a tandem axel dump truck. The proofrolling should be observed by the geotechnical engineer or his representative. The pavement subgrades should be thoroughly proofrolled prior to fine grading to identify soft soils not encountered during the mass grading of the site. Those soft areas should be undercut and replaced with properly compacted fill.

Typically, during construction, the pavement subgrade becomes disturbed because of traffic and environmental conditions. Prior to construction of pavements, it is essential that the subgrade be restored to a properly compacted condition. The specifications should include notes pertaining to subgrade restoration immediately prior to pavement construction. The on-site soils will have a tendency to lose shear strength (and consequently pavement support capability) if they are exposed to excessive moisture. Thus, proper moisture conditioning of the subgrade prior to placement of the pavement base course will result in better pavement performance.

5.3 Flexible Pavement

We have based the pavement design on the materials encountered at the site and in general accordance with the FDOT Flexible Pavement Design Manual, latest edition. We have assumed the traffic loading will consist of less than 75,000 Equivalent Single-Axle Loads (ESALS) of 18 kips for the pavement areas. The pavement subgrade area shall consist of a minimum of 12-inches of stabilized subgrade with a design LBR of 40 and the limerock base material with a design LBR of 100. We have also assumed the design life for the pavement is 20
years, the design terminal serviceability index of 2.0, and a reliability of 85%. If there is a deviation in the assumed traffic data above, GMC should be notified to refine the pavement buildup sections.

<table>
<thead>
<tr>
<th>Pavement Area</th>
<th>Minimum Section Thickness</th>
<th>Pavement Materials</th>
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</thead>
<tbody>
<tr>
<td><strong>Standard Duty Pavements</strong></td>
<td>2.0 inches</td>
<td>Structural Course (FDOT Superave SP-9.5 or SP-12.5)</td>
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<td></td>
<td>6.0 inches</td>
<td>Limerock Base Course (FDOT Approved Source, Minimum LBR of 100)</td>
</tr>
<tr>
<td></td>
<td>12 inches</td>
<td>Stabilized Subgrade (Minimum LBR 40)</td>
</tr>
<tr>
<td><strong>Heavy Duty Pavements</strong></td>
<td>2.5 inches</td>
<td>Structural Course (FDOT Superave SP-9.5 or SP-12.5)</td>
</tr>
<tr>
<td></td>
<td>8.0 inches</td>
<td>Limerock Base Course (FDOT Approved Source, Minimum LBR of 100)</td>
</tr>
<tr>
<td></td>
<td>12 inches</td>
<td>Stabilized Subgrade (Minimum LBR 40)</td>
</tr>
</tbody>
</table>

The pavement sections represent minimum recommended thickness for a pavement section designed for a 20-year life. However, periodic maintenance should be anticipated over the pavement design life. All pavement materials and construction procedures should conform to the Florida Department of Transportation Standard Specifications for Road and Bridge Construction, latest edition. The stabilized subgrade shall be stabilized to have a minimum LBR of 40. Stabilized subgrade and limerock base courses shall be compacted to at least 98% of the modified Proctor maximum dry density (AASHTO T180) and shall not be placed in lifts greater than 6 inches.

**6.0 REPORT LIMITATIONS**

The recommendations submitted are based on the available soil information obtained by GMC and design details furnished by GMC for the proposed project. If there are any revisions to the plans for this project or if deviations from the subsurface conditions noted in this report are encountered during construction, we should be notified immediately to determine if changes in the foundation, or other, recommendations are required. If GMC is not retained to perform these functions, GMC cannot be responsible for the impact of those conditions on the performance of the project.

The geotechnical engineer warrants that the findings, recommendations, specifications, or professional advice contained herein have been made in accordance with generally accepted professional geotechnical engineering practices in the local area. No other warranties are implied or expressed.
After the plans and specifications are more complete, the geotechnical engineer should be provided the opportunity to review the final design plans and specifications to check that our engineering recommendations have been properly incorporated into the design documents. At that time, it may be necessary to submit supplementary recommendations.

We emphasize that this report was prepared for design and informational purposes only and may not be sufficient to prepare an accurate construction budget. Contractors reviewing this report should acknowledge that the recommendations contained herein are for design and informational purposes only. A more comprehensive exploration and testing program would be required to assist the contractor in preparing the final building pad preparation, grading, and foundation construction budgets. In no case should this report be utilized as a substitute for development of specific earthwork specifications.

The information contained in this report is not intended, nor is sufficient, to aid in the design of segmental or mechanically stabilized earth (MSE) retaining walls. Segmental or MSE wall designers and builders should not rely on this report and should perform independent analysis to determine all necessary soil characteristics for use in their wall design, including but not limited to, soil shear strengths, bearing capacities, global stability, etc.
APPENDIX

Site Location Plan
Boring Location Plan
Site Photographs
Soil Classification Chart
Subsurface Diagram
Boring Records
Laboratory Test Results
Field and Laboratory Procedures
Approximate Boring Locations
<table>
<thead>
<tr>
<th>MAJOR DIVISIONS</th>
<th>SYMBOLS</th>
<th>TYPICAL DESCRIPTIONS</th>
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<tbody>
<tr>
<td>GRAVEL AND GRAVELLY SOILS</td>
<td>GW</td>
<td>WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES</td>
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<tr>
<td>(LITTLE OR NO FINES)</td>
<td>GP</td>
<td>POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES</td>
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<tr>
<td>CLEAN GRAVELS</td>
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<td>MORE THAN 50% OF COARSE FRACTION</td>
<td>GM</td>
<td>SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES</td>
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<td>RETAINED ON NO. 4 SIEVE</td>
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<td>CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES</td>
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<td>SANDY SOILS</td>
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<td>WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES</td>
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<td>(LITTLE OR NO FINES)</td>
<td>SP</td>
<td>POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES</td>
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<tr>
<td>SANDS WITH FINES</td>
<td>SM</td>
<td>SILTY SANDS, SAND - SILT MIXTURES</td>
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<td>(APPRECIABLE AMOUNT OF FINES)</td>
<td>SC</td>
<td>CLAYEY SANDS, SAND - CLAY MIXTURES</td>
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<td>MORE THAN 50% OF COARSE FRACTION</td>
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<td>PASSING ON NO. 4 SIEVE</td>
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<td>Silt and Clays</td>
<td>ML</td>
<td>INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SiltS WITH SLIGHT PLASTICITY</td>
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<td>(LITTLE OR NO FINES)</td>
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<td>INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS</td>
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<td>Liquid limit less than 50</td>
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<td>ORGANIC SILTS AND ORGANIC CLAYEY SiltS OF LOW PLASTICITY</td>
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<td>More than 50% of material is larger</td>
<td>MH</td>
<td>INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS</td>
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<td>than no. 200 sieve size</td>
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<td>ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS</td>
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<tr>
<td>More than 50% of material is</td>
<td>PT</td>
<td>PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS</td>
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<tr>
<td>smaller than no. 200 sieve size</td>
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NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS
POORLY GRADED SAND (SP), dark to light yellow, loose to very loose, fine-grained, moist

CLAYEY SAND (SC), yellow and red, medium, fine-grained, moist

CLAYEY SAND (SC), red w/ some yellow, dense, medium-grained, moist

POORLY GRADED SAND (SP), yellow and pink to yellow, medium, coarse-grained, saturated

Boring was terminated at 20.5 feet.
**GROUND ELEVATION** 241 ft  **HOLE SIZE** 4"  

**DRILLING CONTRACTOR** Environmental Resource Group  

**DATE STARTED** 11/26/19  **COMPLETED** 11/26/19  

**LOGGED BY** K. Wales  **CHECKED BY** M. McNeill  

**GROUND WATER LEVELS:**  

**DRILLING METHOD** Kinco Hybrid, Manual-Hammer, SFA w/SPT  

Boring was terminated at 20.5 feet.

<table>
<thead>
<tr>
<th>ELEVATION (ft)</th>
<th>MATERIAL DESCRIPTION</th>
<th>SAMPLE TYPE NUMBER</th>
<th>% RECOVERY (RQD)</th>
<th>BLOW COUNTS (N VALUE)</th>
<th>POCKET PEN. (tsf)</th>
<th>DRY UNIT WT. (pcf)</th>
<th>MOISTURE CONTENT (%)</th>
<th>LIQUID LIMIT</th>
<th>PLASTIC LIMIT</th>
<th>PLASTICITY INDEX (%)</th>
<th>FINES CONTENT</th>
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<tr>
<td>240</td>
<td>POORLY GRADED SAND (SP), light brown and olive gray, loose to medium, fine-grained, moist</td>
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<td>2-5-5 (10)</td>
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<td>POORLY GRADED SAND (SP), yellow, very loose, fine-grained, moist</td>
<td>SS</td>
<td>4-4-6 (10)</td>
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<td>8-10-11 (21)</td>
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<td>SS</td>
<td>6-8-6 (14)</td>
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Boring Number B-3

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<th>Dry Unit Wt. (pcf)</th>
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Client: Northwest Florida State College

PROJECT NAME: Walton Works

DATE STARTED: 11/26/19  COMPLETED: 11/26/19

GROUND ELEVATION: 245 ft  HOLE SIZE: 4"

DRILLING METHOD: Kinco Hybrid, Manual-Hammer, SFA w/SPT

DRILLING CONTRACTOR: Environmental Resource Group

GROUND WATER LEVELS: AT TIME OF DRILLING: not encountered

LOGGED BY: K. Wales  CHECKED BY: M. McNeill

AFTER DRILLING: ---

NOTES: ---

DATE STARTED: 11/26/19  COMPLETED: 11/26/19

HOLE SIZE: 4"
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<tr>
<th>ELEVATION (ft)</th>
<th>MATERIAL DESCRIPTION</th>
<th>SAMPLE TYPE</th>
<th>RECOVERY (RQD)</th>
<th>BLOW COUNTS (N VALUE)</th>
<th>POCKET PEN. (tsf)</th>
<th>TREND</th>
<th>ATTERBERG LIMITS</th>
<th>PLASTICITY INDEX</th>
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Boring was terminated at 15.5 feet.
POORLY GRADED SAND (SP), gray and dark yellow, very loose, fine-grained, moist

POORLY GRADED SAND (SP), yellow, very loose, fine-grained, moist

POORLY GRADED SAND with CLAY (SP-SC), light red and yellow, very loose, fine-grained, saturated

POORLY GRADED SAND (SP), red and yellow, medium, medium to coarse-grained, saturated

Boring was terminated at 15.5 feet.
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<tr>
<th>ELEVATION (ft)</th>
<th>MATERIAL DESCRIPTION</th>
<th>SAMPLE TYPE</th>
<th>RECOVERY (%)</th>
<th>BLOW COUNTS (N-value)</th>
<th>POCKET PEN (ft)</th>
<th>DRY UNIT WT (pcf)</th>
<th>MOISTURE CONTENT (%)</th>
<th>LIQUID LIMIT</th>
<th>PLASTIC LIMIT</th>
<th>PLASTICITY INDEX (%)</th>
<th>FINE CONTENT (%)</th>
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Boring was terminated at 15.5 feet.
### GRAIN SIZE DISTRIBUTION

**CLIENT**  Northwest Florida State College  
**PROJECT NUMBER**  GPEN190001  
**PROJECT NAME**  Walton Works  
**PROJECT LOCATION**  DeFuniak Springs, FL

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FIELD TEST PROCEDURES

General

The general field procedures employed by Goodwyn, Mills and Cawood, Inc. (GM&C), are summarized in the American Society for Testing and Materials (ASTM) Standard D420 which is entitled "Investigating and Sampling Soil and Rock". This recommended practice lists recognized methods for determining soil and rock distribution and groundwater conditions. These methods include geophysical and in-situ methods as well as borings.

The detailed collection methods used during this exploration are presented in the following paragraphs.

Standard Drilling Techniques

General: To obtain subsurface samples, borings are drilled using one of several alternate techniques depending upon the subsurface conditions. These techniques are as follows:

In Soils:
   a) Continuous hollow stem augers.
   b) Rotary borings using roller cone bits or drag bits, and water or drilling mud to flush the hole.
   c) "Hand" augers.

In Rock:
   a) Core drilling with diamond-faced, double or triple tube core barrels.
   b) Core boring with roller cone bits.

Hollow Stem Auger: A hollow stem augers consists of a hollow steel tube with a continuous exterior spiral flange termed a flight. The auger is turned into the ground, returning the cuttings along the flights. The hollow center permits a variety of sampling and testing tools to be used without removing the auger.

Rotary Borings: Rotary drilling involves the use of roller cone or drag type drill bits attached to the end of drill rods. A flushing medium, normally water or bentonite slurry, is pumped through the rods to clear the cuttings from the bit face and flush them to the surface. Casing is sometimes set behind the advancing bit to prevent the hole from collapsing and to restrict the penetration of the drilling fluid into the surrounding soils. Cuttings returned to the surface by the drilling fluid are typically collected in a settling tank, to allow the fluid to be recirculated.

Hand Auger Boring: Hand auger borings are advanced by manually twisting a 4" diameter steel bucket auger into the ground and withdrawing it when filled to observe the sample collected. Posthole diggers are sometimes used in lieu of augers to obtain shallow soil samples. Occasionally these hand auger borings are used for driving 3-inch diameter steel tubes to obtain intact soil samples.

Core Drilling: Soil drilling methods are not normally capable of penetrating through hard cemented soil, weathered rock, coarse gravel or boulders, thin rock seams, or the upper surface of sound, continuous rock. Material that cannot be penetrated by auger or rotary soil-drilling methods at a reasonable rate is designated as "refusal material". Core drilling procedures are required to penetrate and sample refusal materials.
Prior to coring, casing may be set in the drilled hole through the overburden soils, to keep the hole from caving and to prevent excessive water loss. The refusal materials are then cored according to ASTM D2113 using a diamond studded bit fastened to the end of a hollow, double or triple tube core barrel. This device is rotated at high speeds, and the cuttings are brought to the surface by circulating water. Core samples of the material penetrated are protected and retained in the swivel-mounted inner tube. Upon completion of each drill run, the core barrel is brought to the surface, the core recovery is measured, and the core is placed, in sequence, in boxes for storage and transported to our laboratory.

**Sampling and Testing in Boreholes**

**General:** Several techniques are used to obtain samples and data in soils; however, the most common methods in this area are:

a) **Standard Penetrating Testing**

b) **Water Level Readings**

These procedures are presented below. Any additional testing techniques employed during this exploration are contained in other sections of the Appendix.

**Standard Penetration Testing:** At regular intervals, the drilling tools are removed and soil samples obtained with a standard 2-inch diameter split tube sampler connected to an A or N-size rod. The sampler is first seated 6 inches to penetrate any loose cuttings, and then driven an additional 12 inches with blows of a 140-pound safety hammer falling 30 inches. Generally, the number of hammer blows required to drive the sampler the final 12 inches is designated the “penetration resistance” or “N” value, in blows per foot (bpf). The split barrel sampler is designed to retain the soil penetrated, so that it may be returned to the surface for observation. Representative portions of the soil samples obtained from each split barrel sample are placed in jars, sealed and transported to our laboratory.

The standard penetration test, when properly evaluated, provides an indication of the soil strength and compressibility. The tests are conducted according to ASTM Standard D1586. The depths and N-values of standard penetration tests are shown on the Boring Records. Split barrel samples are suitable for visual observation and classification tests but are not sufficiently intact for quantitative laboratory testing.

**Water Level Readings:** Water table readings are normally taken in the borings and are recorded on the Boring Records. In sandy soils, these readings indicate the approximate location of the hydrostatic water table at the time of our field exploration. In clayey soils, the rate of water seepage into the borings is low and it is generally not possible to establish the location of the hydrostatic water table through short-term water level readings. Also, fluctuation in the water table should be expected with variations in precipitation, surface run-off, evaporation, and other factors. For long-term monitoring of water levels, it is necessary to install piezometers.

The water levels reported on the Boring Records are determined by field crews immediately after the drilling tools are removed, and several hours after the borings are completed, if possible. The time lag is intended to permit stabilization of the groundwater table, which may have been disrupted by the drilling operation.
Occasionally the borings will cave-in, preventing water level readings from being obtained or trapping drilling water above the cave-in zone. The cave-in depth is measured and recorded on the Boring Records.
Boring Records

The subsurface conditions encountered during drilling are reported on a field boring record prepared by the Driller. The record contains information concerning the boring method, samples attempted and recovered, indications of the presence of coarse gravel, cobbles, etc., and observations of ground water. It also contains the driller’s interpretation of the soil conditions between samples. Therefore, these boring records contain both factual and interpretive information. The field boring records are kept on file in our office.

After the drilling is completed, a geotechnical professional classifies the soil samples and prepares the final Boring Records, which are the basis for all evaluations and recommendations. The following terms are taken from ASTM D2487 or Deere’s Technical Description of Rock Cores for Engineering Purposes, Rock Mechanical Engineering Geology 1, pp. 18-22.

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<th>Consistency of Cohesive Soils</th>
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<td>Very Soft</td>
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<tr>
<td>Loose</td>
<td>Soft</td>
</tr>
<tr>
<td>Medium</td>
<td>Medium</td>
</tr>
<tr>
<td>Dense</td>
<td>Stiff</td>
</tr>
<tr>
<td>Very Dense</td>
<td>Very Stiff</td>
</tr>
<tr>
<td>(bpf = blows per foot, ASTM D 1586)</td>
<td>Hard</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Relative Hardness of Rock</th>
<th>Particle Size Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Soft Rock disintegrates or easily compresses to touch; can be hard to very hard soil.</td>
<td>Boulders Larger than 12”</td>
</tr>
<tr>
<td>Soft Rock may be broken with fingers.</td>
<td>Cobbles 3” - 12”</td>
</tr>
<tr>
<td>Moderately Soft Rock may be scratched with a nail, corners and edges may be broken with fingers.</td>
<td>Gravel Coarse 3/4” - 3”</td>
</tr>
<tr>
<td>Moderately Hard Rock a light blow of hammer is required to break samples.</td>
<td>Fine 4.76mm - 3/4”</td>
</tr>
<tr>
<td>Hard Rock a hard blow of hammer is required to break sample.</td>
<td>Sand 2.0 - 4.76 mm</td>
</tr>
<tr>
<td>RQD</td>
<td>Fines (Silt or Clay) Smaller than 0.074 mm</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Rock Continuity</th>
<th>Relative Quality of Rocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>RECOVERY = ( \frac{\text{Total Length of Core}}{\text{Length of Core Run}} ) x 100 %</td>
<td>RQD = ( \frac{\text{Total core, counting only pieces &gt; 4” long}}{\text{Length of Core Run}} ) x 100 %</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Core Recovery %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incompetent</td>
<td>Less than 40</td>
</tr>
<tr>
<td>Competent</td>
<td>40 - 70</td>
</tr>
<tr>
<td>Fairly Continuous</td>
<td>71 - 90</td>
</tr>
<tr>
<td>Continuous</td>
<td>91 - 100</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>RQD %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Very Poor</td>
<td>0 - 25 %</td>
</tr>
<tr>
<td>Poor</td>
<td>25 - 50 %</td>
</tr>
<tr>
<td>Fair</td>
<td>50 - 75 %</td>
</tr>
<tr>
<td>Good</td>
<td>75 - 90 %</td>
</tr>
<tr>
<td>Excellent</td>
<td>90 - 100 %</td>
</tr>
</tbody>
</table>
LABORATORY TESTING

GENERAL
The laboratory testing procedures employed by Goodwyn, Mills and Cawood, Inc. (GM&C) are in general accordance with ASTM standard methods and other applicable specifications.

Several test methods, described together with others in this Appendix, were used during the course of this exploration. The Laboratory Data Summary sheet indicates the specific tests performed.

SOIL CLASSIFICATION
Soil classifications provide a general guide to the engineering properties of various soil types and enable the engineer to apply his past experience to current problems. In our investigations, samples obtained during drilling operations are examined in our laboratory and visually classified by an engineer. The soils are classified according to consistency (based on number of blows from standard penetration tests), color and texture. These classification descriptions are included on our "Boring Records".

The classification system discussed above is primarily qualitative and for detailed soil classification two laboratory tests are necessary; grain size tests and plasticity tests. Using these test results the soil can be classified according to the AASHTO or Unified Classification Systems (ASTM D-2487). Each of these classification systems and the in-place physical soil properties provides an index for estimating the soil's behavior. The soil classification and physical properties obtained are presented in this report.

MOISTURE CONTENT
Moisture contents are determined from representative portions of the specimen. The soil is dried to a constant weight in an oven at 100° C and the loss of moisture during the drying process is measured. From this data, the moisture content is computed.

PARTICLE SIZE DISTRIBUTION
The distribution of soils coarser than the No. 200 (75-mm) sieve is determined by passing a representative specimen through a standard set of nested sieves. The weight of material retained on each sieve is determined and the percentage retained (or passing) is calculated.

A specimen may be washed through only the No. 200 sieve, if the full range of particle sizes is not required. The percentage of material passing the No. 200 sieve is reported.

The distribution of materials finer than the No. 200 sieve is determined by use of a hydrometer. The particle sizes and distribution are computed from the time rate of settlement of the different size particles while suspended in water. These tests are performed in accordance with ASTM D-421, D-422 and D-1140.

PERMEABILITY TEST
The permeability test is used to measure the ease with which water will flow through soils, such as seepage through liners or under dams, the squeezing out of water from the soil by the application of load and drainage of subgrades, dams and backfills.
The permeability test is conducted on undisturbed or remolded samples. Samples are trimmed to 1.4 or 2.85 inches in diameter and are variable heights. The samples are molded or trimmed and placed in a ring and placed between porous plates. Water is forced to flow through the sample and the rate of flow is determined.

Two methods of permeability are used, depending on the grain size of soils.

- Constant head method per ASTM D-2434.
- Falling head method per ASTM D-5084.
DATE: January 20, 2020

PROJECT: Walton Works Project – Defuniak Springs Campus
Northwest Florida State College

PROPOSAL OF
hereinafter called “Bidder”, a (corporation) (partnership) (sole proprietorship) (Bidder strike out inapplicable terms)

TO
Bay Health Foundation (hereinafter called “Owner”)

The undersigned, in compliance with your Advertisement for Bids, submits the following Bid.

1.1 REPRESENTATIONS

   A. Bidder will accept the provisions of the Bidding Documents.
   B. Bidder will enter into and execute a contract with the Owner within 10 days after notification of the acceptance of this Bid.
   C. Bidder will accomplish the Work in accordance with the Bidding Documents prepared by Goodwyn, Mills and Cawood.

1.2 TIME OF COMPLETION

   A. Bidder proposes to achieve Substantial Completion of the Work within the following calendar days after a Notice to Proceed is issued:

   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________
   Days (_______________)

1.3 BID AMOUNTS

   A. Base Bid Amount: Bidder proposes to construct this project for the stipulated sum of:

   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________
   ____________________________________________________________________________
   Dollars (_______________)

1.4 ADDENDA

   A. Bidder acknowledges receipt of the following Addenda:

   No. _______ Dated ____________________, 20____
   No. _______ Dated ____________________, 20____
   No. _______ Dated ____________________, 20____
   No. _______ Dated ____________________, 20____

Respectfully Submitted,
Firm Name

By

Street Address

Signature

City, State and Zip Code

Title

Telephone

Corporations: Affix Corporate Seal

State in which incorporated

END OF DOCUMENT
The undersigned, in compliance with your Advertisement for Bids, submits the Supplements to the Bid Form listed below. The information provided shall be considered as an integral part of the Bid Form previously submitted.

These Appendices are as follows:

1. Proposed Subcontractors: Includes the names of Subcontractors and the portions of the Work they will perform. DUE WITH PROPOSAL AT TIME OF BID.

2. Base Bid Amount Breakdown: Identifies the cost breakdown of the previously submitted Base Bid amount into the portions of the Work requested. DUE WITHIN 24 HOURS OF BID.

Respectfully submitted,

Firm Name

Name of Officer

Signature of Officer
Bidder proposes to use the following Subcontractors for the portions of the Work indicated.

<table>
<thead>
<tr>
<th>SPECIFICATION SECTION</th>
<th>SUBCONTRACTOR</th>
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<tbody>
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</tbody>
</table>
BASE BID AMOUNT BREAKDOWN

The following is a breakdown of the Base Bid Amount into amounts attributable to the portions of the Work indicated. Contractor’s overhead and profit shall be included as a separate line item. DUE WITHIN 24 HOURS AFTER BID OPENING

<table>
<thead>
<tr>
<th>ITEM OF WORK</th>
<th>VALUE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$_______</td>
</tr>
</tbody>
</table>
1.1 SUMMARY

A. Related Documents:
   1. Document 00 7300 - Supplementary Conditions.
   2. Division 01 - General Requirements.

1.2 DOCUMENT

A. American Institute of Architects (AIA) Document A201-2007, General Conditions of the Contract for Construction, forms a part of this Contract and by reference is incorporated herein as fully as if repeated at length.

END OF DOCUMENT
1.1 SUMMARY

A. Related Documents:
   1. Document 00 7200 - General Conditions.
   2. Division 01 - General Requirements.

1.2 GENERAL

A. The following supplements modify, delete from, or add to the General Conditions referenced above.

B. Where provisions of the General Conditions are modified, unaltered provisions remain in effect.

1.3 SUPPLEMENTS

A. Article 1 - General Provisions:

1. Add Subparagraph 1.1.9:
   1.1.9 The term “product” includes materials, systems, and equipment.

2. Add Subparagraph 1.1.10:
   1.1.10 The term “furnish” means to supply and deliver to Project site, ready for unloading, unpacking, assembly, erection, placement or similar requirements.

3. Add Subparagraph 1.1.11:
   1.1.11 The term “install” means to unload, unpack, assemble, erect, place, finish, protect, adjust, and clean, or similar requirements.

4. Add Subparagraph 1.1.12:
   1.1.12 The term “provide” means to furnish and install.

B. Article 8 - Time:

1. Add Subparagraph 8.2.4:
   8.2.4 The Owner will suffer financial loss if Substantial Completion has not been reached on or before the date established in the Bidding Documents. The Contractor shall be liable for and shall pay to the Owner the sum of $500/day as fixed and agreed liquidated damages for each day of delay until the project is Substantially Complete.

C. Article 9 - Payments and Completion:

1. Add Subparagraph 9.6.8:
   9.6.8 Until final payment the Owner will retain 10 percent of the amount due the Construction Manager on account of progress payments.

D. Article 10 - Protection of Persons and Property:

1. Add Paragraph 10.3.7:
   10.3.7 The Contractor shall not knowingly use any materials containing asbestos or other known hazardous materials in the Work.
E. Article 11 - Insurance and Bonds:

1. In Subparagraph 11.1.1, following the word "located", add "and against whom the Owner has no reasonable objection."

2. Add the following to the end of Subparagraph 11.1.3: "The form of the Certificate of Insurance shall be acceptable to the Owner."

3. Add Subparagraph 11.1.5:

   11.1.5 Liability insurance shall include all major divisions of coverage and be on a comprehensive basis including:
   .1 Premises-Operations including X, C and U coverages as applicable.
   .2 Independent Contractors' Protective.
   .3 Products and Completed Operations.
   .4 Personal Injury Liability with Employment Exclusion deleted.
   .5 Contractual, including specified provision for Contractor's obligation under Paragraph 3.18.
   .6 Owned, non owned and hired motor vehicles.
   .7 Broad Form Property Damage including Completed Operations."

4. Add Subparagraph 11.1.6:

   11.1.6 The insurance required by Subparagraph 11.1.1 shall be written for not less than the limits proposed by the Construction manager and approved by the Owner or those required by law, whichever is greater.

5. Modify the first sentence of Subparagraph 11.3.1 as follows: Delete "Unless otherwise provided, the Owner"; substitute "The Contractor."

6. Delete Subparagraph 11.4.1; substitute the following:

   11.4.1 Furnish to Owner performance bond and labor and material payment bond, each equal to the amount of the Contract Sum, with approved surety, covering faithful performance of Contract and payment of obligations incurred in performance of Contract and also for use and benefit of parties who may become entitled to liens under the Contract according to provisions of laws of the State in which the project is located. The form of the bonds shall be acceptable to Owner.
   .1 The Contractor shall deliver the required bonds to the Owner not later than three days following the date of execution of the Owner-Contractor Agreement, or if the Work is to be commenced prior thereto in response to a letter of intent, the Contractor shall, prior to commencement of the Work, submit evidence satisfactory to the Owner that such bonds will be furnished.
   .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.

F. Article 13 - Miscellaneous Provisions:

1. Add Paragraph 13.8:

   13.8 Equal Opportunity

   13.8.1 The Construction Manager and 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 ensure 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 Construction Manager agrees to post in conspicuous places, available to employees and applicants for employment, notices setting forth the policies of nondiscrimination.

13.8.2 The Construction Manager and 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.]

G. Article 15 - Claims and Disputes:

END OF DOCUMENT
PART 1  GENERAL

1.1  SUMMARY

A. Section Includes:
   1. Cash allowances.

B. Related Sections
   1. Section 01 2900 - Payment Procedures.
   2. Section 01 3216 - Construction Progress Schedules.
   3. Individual specification sections.

C. Include in Contract Sum cash allowances specified in individual sections.

D. Designate in Construction Progress Schedule specified in Section 01 3216 delivery dates for products under each allowance.

E. Designate in Schedule of Values specified in Section 01 2900 quantities of materials specified under unit cost allowances.

1.2  CASH ALLOWANCES

A. General:
   1. Purchase products under each allowance as directed by Architect.
   2. Amount of allowance includes:
      a. Net cost of product, less any applicable trade discounts.
      b. Delivery to site.
      c. Labor required under allowance, only when labor is specified to be included in allowance.
   3. In addition to amounts of allowances, include in Contract Sum, Construction Manager's costs for:
      a. Handling at site, including unloading, uncrating, and storing.
      b. Protection from elements and from damage.
      c. Labor required for installation and finishing, except where installation is specified to be part of allowance.
      d. Other expenses required to complete installation.
      e. Overhead and profit.

B. Selection of Products:
   1. Architect's Duties:
      a. Consult with Construction Manager in consideration of products and suppliers.
      b. Make selection; designate products to be used.
      c. Prepare Change Orders.
   2. Construction Manager's Duties:
      a. Assist Architect in determining:
         1) Supplier or installer, as applicable.
         2) Cost, delivered and unloaded at site.
      b. Obtain proposals from suppliers when requested by Architect.
      c. Notify Architect of any effect anticipated by selection of product or supplier under consideration on construction schedule or contract sum.
      d. On notification of selection, enter into purchase agreement with designated supplier.

C. Delivery:
   1. Construction Manager's Duties:
      a. Arrange for delivery and unloading.
      b. Promptly inspect products for damage or defects.
      c. Submit any claims for transportation damage.
D. Installation: Comply with requirements of referenced specification section.

E. Adjustment of Costs:
   1. Should actual purchase cost be more or less than specified amount of allowance, Contract Sum will be adjusted by Change Order equal to amount of difference.
   2. Amount of Change Order will recognize any changes in handling costs at site, labor, installation costs, overhead, profit, and other expenses caused by selection under allowance.
   3. For products specified under unit cost allowance, unit cost shall apply to quantity listed in Schedule of Values.
   4. Submit invoices or other data to substantiate quantity actually used.
   5. Submit any claims for additional costs at site or other expenses caused by selection under allowances, prior to execution of work. Failure to do so will constitute waiver of claims for additional costs.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Schedule of allowances: Face Brick: $400/1000 brick material only

END OF SECTION
SECTION 01 2500
SUBSTITUTION PROCEDURES

PART 1  GENERAL

1.1  SUMMARY

A.  Section Includes:
   1.  Product Substitution Procedures.

1.2  GENERAL

A.  Definition: Proposal by Construction Manager to use manufacturer, product, material, or system
different from one required in Contract Documents.

B.  Do not substitute Products unless a substitution request has been approved by Architect.

C.  Substitutions during Bidding: Refer to Instructions to Bidders.

D.  Architect will consider substitution requests within 30 days after award of Contract. After initial 30 day
period, substitutions requests will be considered only due to non-availability of a specified Product
through no fault of Construction Manager.

E.  In case of non-availability of a specified Product notify Architect in writing as soon as non-availability
becomes apparent.

1.3  SUBSTITUTION REQUESTS

A.  Submit substitution requests on Construction Manager’s standard form.

B.  Document specified product and proposed substitution with complete data, including:
   1.  Product identification, including name and address of manufacturer.
   3.  Sample, if requested.
   4.  Description of any anticipated effect that acceptance of proposed substitution will have on
       Progress Schedule, construction methods, or other items of Work.
   5.  Description of any differences between specified product and proposed substitution.
   6.  Difference in cost between specified product and proposed substitution.

C.  Burden of proof for substantiating compliance of proposed substitution with Contract Document
requirements remains with Construction Manager.

D.  A request constitutes a representation that the Construction Manager:
   1.  Has investigated the proposed Product and determined that it meets or exceeds the quality
       level of the specified Product.
   2.  Will provide the same warranty for the substitution as for the specified Product.
   3.  Will coordinate installation and make changes to other Work that may be required for the Work
       to be complete with no additional cost to Owner.
   4.  Waives claims for additional costs or time extension that may subsequently become apparent.
   5.  Will reimburse Owner for design services associated with re-approval by authorities or revisions
       to Contract Documents to accommodate the substitution.

E.  Substitutions will not be considered if:
   1.  They are indicated or implied on Shop Drawings or other submittals without submittal of a
       substitution request.
   2.  Approval will require substantial revision of Contract Documents without additional
       compensation to Architect.

F.  Submit electronically in Adobe PDF format.
G. Architect will notify Construction Manager of approval or rejection of each Substitution Request.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION
DATE: __________________________________________

TO: _____________________________________________________________________________________________

ATTENTION: _______________________________________________________________________________________

PROJECT: _________________________________________________________________________________________

We submit for your consideration the following product as a substitution for the specified product:

<table>
<thead>
<tr>
<th>Section No.</th>
<th>Paragraph</th>
<th>Specified Product</th>
</tr>
</thead>
<tbody>
<tr>
<td>___________</td>
<td>__________</td>
<td>______________________________________________________</td>
</tr>
</tbody>
</table>

Proposed Substitution: _____________________________________________________________________________

Reason for Substitution: ___________________________________________________________________________

Product Data:

Attach complete technical data for both the specified product and the proposed substitution. Include information on changes to Contract Documents that the proposed substitution will require for its proper installation.

Samples:

___ Attached    ___ Will be furnished upon request

Does the substitution affect dimensions shown on Drawings?

___ No    ___ Yes (explain) __________________________________________________________

Effects of proposed substitution on other Work:

______________________________________________________________________________________________

______________________________________________________________________________________________

Differences between proposed substitution and specified Product:

______________________________________________________________________________________________

______________________________________________________________________________________________

Manufacturer’s warranties of the proposed substitution are:

___ Same    ___ Different (explain) ________________________________________________________________
Maintenance service and spare parts are available for proposed substitution from:

________________________________________________________________________

________________________________________________________________________

Previous installations where proposed substitution may be seen:

<table>
<thead>
<tr>
<th>Project:</th>
<th>Project:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner:</td>
<td>Owner:</td>
</tr>
<tr>
<td>Architect:</td>
<td>Architect:</td>
</tr>
<tr>
<td>Date Installed:</td>
<td>Date Installed:</td>
</tr>
</tbody>
</table>

Cost savings to be realized by Owner, if proposed substitution is approved:

________________________________________________________________________

Change to Contract Time, if proposed substitution is approved:

___ No Change       ___ Add ________ days       ___ Deduct ________ days

Submittal constitutes a representation that [Contractor] [Construction Manager] has read and agrees to the provisions of Section 01 2500.

Submitted by [Contractor:] [Construction Manager:]

________________________________________________________________________

Signature

________________________________________________________________________

Firm

For Use by Architect:

Based on the information supplied by the [Contractor,] [Construction Manager,] the Architect has reviewed the proposed substitution on the basis of design concept of the Work and conformance with information given in Contract Documents.

___ Approved       ___ Approved as Noted       ___ Rejected

Submit Additional Information:

________________________________________________________________________

________________________________________________________________________

By: ___________________________ Date: ___________________________
SECTION 01 2600

CONTRACT MODIFICATION PROCEDURES

PART 1  GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Supplemental Instructions.
   2. Proposal Requests.
   3. Construction Manager proposed changes.
   5. Change Orders.

B. Related Sections:
   1. Section 01 6000 - Product Requirements.

1.2 CHANGE PROCEDURES

A. Architect's Supplemental Instructions:
   1. Architect will advise of minor changes in Work not involving an adjustment to Contract Sum or Contract Time as authorized by the Conditions of the Contract.

B. Proposal Requests:
   2. Architect may issue a Proposal Request that includes a detailed description of a proposed change with supplemental or revised Drawings and specifications.
   3. Prepare and submit an estimate of any change to Contract Sum or Contract Time within 7 days after receipt. Include:
      a. Quantities and unit costs, with total cost or credit to Owner. If requested, furnish documentation of quantities.
      b. Taxes, delivery charges, equipment rentals, and trade discounts as applicable.
      c. If change in Contract Time is involved, provide updated Progress Schedule.
   4. Do not stop work or initiate changes in response to a Proposal Request. If approved, Architect will prepare and issue a Change Order.
   5. Submit electronically in Adobe PDF format.

C. Construction Manager Proposed Changes:
   1. Format: Construction Manager's standard.
   2. Construction Manager may propose a change by submitting request for change to Architect.
   3. Describe proposed change, reason for change, its full effect on Work, and any change to Contract Sum or Contract Time. Include:
      a. Quantities and unit costs, with total cost or credit to Owner. If requested, furnish documentation of quantities.
      b. Taxes, delivery charges, equipment rentals, and trade discounts as applicable.
      c. If change in Contract Time is involved, provide updated Progress Schedule.
   4. Document any required substitutions in accordance with Section 01 6000.
   5. Submit electronically in Adobe PDF format.

D. Construction Change Directive:
   1. Architect may issue a directive, signed by Owner, instructing Construction Manager to proceed with a change for subsequent inclusion in a Change Order.
   2. Documentation will describe changes in Work and designate method of determining any change to Contract Sum or Contract Time. Promptly execute change.

E. Change Orders:
   2. Execution: Prepare Change Orders for signature of parties as provided in Conditions of the Contract. Submit electronically in Adobe PDF format.
PART 2  PRODUCTS

Not used

PART 3  EXECUTION

Not used

END OF SECTION
SECTION 01 2613
REQUESTS FOR INFORMATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requests for Information (RFI’s).

B. Related Sections:
   1. Section 01 2500 - Substitution Procedures.
   2. Section 01 2600 - Contract Modification Procedures.
   3. Section 01 3300 - Submittal Procedures.
   4. Section 01 7700 - Closeout Procedures.

1.2 GENERAL

A. Request for Information (RFI): Request from Construction Manager seeking interpretation or clarification of Contract Documents not involving Substitutions or changes to Contract Sum or Contract Time.

B. RFI’s constitute a request for information only.

C. Do not submit RFI’s:
   1. To request approval of Substitutions; refer to Section 01 2500.
   2. To request changes known to include changes to Contract Sum or Contract Time; refer to Section 01 2600.
   3. To request approval of submittals; refer to Section 01 3300.
   4. To submit Project Record Documents; refer to Section 01 7700.

1.3 SUBMITTAL

A. Submit RFI’s on Construction Manager’s standard form.

B. Include on each RFI:
   1. Name of Construction Manager.
   2. Project name.
   3. Date submitted.
   4. Sequential RFI number.
   5. Applicable Drawing sheet and detail numbers or Specification Section numbers.
   6. Date when response information is required to avoid impact on Construction Schedule and Construction Cost.

C. Review and sign RFI’s submitted by Subcontractors, Sub-Subcontractors, or Suppliers prior to submittal to Architect.

D. Maintain log of RFI’s showing RFI number and current status of each RFI.

E. When RFI’s require submittal of drawings, follow submittal procedures specified for Shop Drawings in Section 01 3300.

F. Submit electronically in Adobe PDF format.

G. Allow minimum 7 days for Architect’s review and response to each RFI.

PART 2 PRODUCTS

Not used
PART 3 EXECUTION

Not used

END OF SECTION
SECTION 012900
PAYMENT PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Schedule of Values.
   2. Applications for Payment.

B. Related Sections:
   1. Section 017700 - Closeout Procedures.

1.2 SCHEDULE OF VALUES

A. General:
   1. Submit a Schedule of Values to Architect at least 20 days prior to submitting first Application for Payment.
   2. Upon request of Architect, furnish additional data to support values given that will substantiate their correctness.
   3. Approved Schedule of Values will be used as basis for reviewing Contractor’s Applications for Payment.

B. Form and Content:
   2. Use Table of Contents of Project Manual as basis of format for listing costs of Work.
   3. List installed value of component parts of Work in sufficient detail to serve as basis for computing values for progress payments.
   4. Include separate line items for:
      a. Site mobilization.
      b. Bonds and insurance.
      c. Contractor’s overhead and profit.
   5. For items on which payment will be requested for stored materials, break down value into:
      a. Cost of materials, delivered and unloaded [with taxes paid].
      b. Total installed value.
   6. For each line item that has a value of more than $25,000.00, break down costs to list major products or operations under each item.
   7. Total of costs listed in Schedule shall equal Contract Sum.

C. Submit electronically in Adobe PDF format.

D. Review and Resubmittal:
   1. After initial review by Architect, revise and resubmit if required.
   2. Revise and resubmit along with next Application for Payment when a Change Order is issued. List each Change Order as a new line item.

1.3 APPLICATIONS FOR PAYMENT

A. Preparation:
   2. Prepare required information in typewritten format or on electronic media format.
   3. Use data from reviewed Schedule of Values. Provide dollar value in each column for each line item representing portion of work performed.
   4. List each authorized Change Order as a separate line item, listing Change Order number and dollar value.
   5. Prepare Application for Final Payment as specified in Section 017700.
B. Waivers of Lien:
   1. Along with each Application for Payment, submit waivers of lien from Contractor and each Subcontractor or Sub-subcontractor included on the current month's Application for Payment.
   2. Submit partial waivers on each item for amount requested, prior to deduction of retainage.
   3. For completed items, submit full or final waiver.

C. Substantiating Data:
   1. When Architect requires substantiating information, submit data justifying dollar amounts in question.
   2. Provide one copy of data with cover letter showing Application number and date, and line item number and description.

D. Submittal:
   1. Submit one electronic copy in Adobe PDF format of each Application for Payment.
   2. Payment period: Submit at intervals stipulated in Owner/Contractor Agreement.

PART 2 PRODUCTS
   Not used

PART 3 EXECUTION
   Not used

END OF SECTION
SECTION 013100
PROJECT MANAGEMENT AND COORDINATION

PART 1  GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Project coordination.
   2. Coordination drawings.
   3. Project meetings.
B. Related Sections:
   1. Section 017700 - Contract Closeout.

1.2 PROJECT COORDINATION
A. Submit required project submittals electronically in Adobe PDF format.
B. Coordinate scheduling, submittals, and work of various Sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements.
C. Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service such equipment.
D. Coordinate space requirements and installation of mechanical and electrical items that are indicated diagrammatically on Drawings.
   1. Follow routing shown as closely as practical; place runs parallel with building lines.
   2. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
E. In finished areas, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.
F. Coordinate completion and clean up of work of separate Sections in preparation for Substantial Completion.
G. After Owner occupancy, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents to minimize disruption of Owner’s activities.

1.3 COORDINATION DRAWINGS
A. Coordination Drawings:
   1. Prior to commencement of Work, prepare coordination drawings to define relationship of mechanical, plumbing, fire protection, and electrical components with beams, columns, ceilings and walls.
   2. Include plans, elevations, sections, and details required to define relationships between components.
   3. Prepare drawings at 1/4 inch = 1'-0" scale for general layout and 3/8 inch = 1'-0" for plans and sections in congested areas including equipment spaces.
   4. Submit electronically in Adobe PDF format.
B. Hold coordination meetings with trades providing mechanical, plumbing, fire protection, and electrical work.
C. Resolve conflicts between trades, prepare composite coordination drawings and obtain signatures on original composite coordination Drawings.

D. When conflicts cannot be resolved:
   1. Cease work in areas of conflict and request clarification prior to proceeding.
   2. Prepare drawings to define and to indicate proposed solution.
   3. Submit drawings for approval when actual measurements and analysis of Drawings and Project Manual indicate that various systems cannot be installed without significant deviation from intent of Contract Documents.

E. Submit original composite coordination drawings as part of Project Record Documents specified in Section 017700.

1.4 PROJECT MEETINGS

A. Schedule and administer preconstruction conference, progress meetings and pre-installation conferences.

B. Make physical arrangements for meetings; notify involved parties at least 4 days in advance.

C. Record significant proceedings and decisions at each meeting; reproduce and distribute copies to parties in attendance and others affected by proceedings and decisions made.

1.5 PRECONSTRUCTION CONFERENCE

A. Schedule within 15 days after date of Notice to Proceed at central site convenient to all parties.

B. Attendance:
   1. Contractor.
   2. Owner.
   3. Architect
   4. Major subcontractors and suppliers as Contractor deems appropriate.
   5. Representative of Testing Laboratory.

C. Review and Discuss:
   1. Relation and coordination of various parties, and responsible personnel for each party.
   2. Use of premises, including office and storage areas, temporary controls, and security procedures.
   3. Construction schedule and critical work sequencing.
   4. Processing of:
      a. Contract modifications.
      b. Shop Drawings, Product Data, and Samples.
      c. Applications for Payment.
      d. Substitutions.
      e. Requests for Information.
      f. Other required submittals.
   8. Notification procedures and extent of testing and inspection services.

1.6 PROGRESS MEETINGS

A. Schedule weekly progress meetings.

B. Location: Contractor’s Project field office.
C. Attendance:
   1. Contractor.
   2. Owner.
   3. Architect and consultants as appropriate to agenda.
   4. Subcontractors and suppliers as appropriate to agenda.
   5. Others as appropriate to agenda.

D. Review and Discuss:
   1. Work progress since previous meeting, including:
      a. Field observations, deficiencies, conflicts, and problems.
      b. Progress and completion date.
      c. Corrective measures needed to maintain quality standards, progress, and completion date.
   2. Status of:
      a. Requests for information.
      b. Submittals.
      c. Contract modifications.
   3. Coordination between various elements of Work.
   4. Maintenance of Project Record Documents.

1.7 PRE-INSTALLATION CONFERENCES

A. Where required in individual specification Section, convene a pre-installation conference at project site or other designated location.

B. Require attendance of parties directly affecting or affected by work of the specific Section.

C. Review conditions of installation, preparation and installation procedures, and coordination with related work.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION
SECTION 013216
CONSTRUCTION PROGRESS SCHEDULES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Construction progress schedule.

B. Related Sections:
   1. Section 011100 - Summary of Work:
   2. Section 012900 - Payment Procedures.

1.2 FORMAT

A. Prepare Progress Schedule on network analysis system using the critical path method.

B. Sequence of Listings: The chronological order of the start of each item of Work.

C. Scale and Spacing: To provide space for notations and revisions.

D. Sheet Size: Multiples of 8-1/2 x 11 inches.

1.3 CONTENT

A. Show complete sequence of construction by activity, with dates for beginning and completion of each element of construction.

B. Identify each item by specification Section number.

C. Identify work of separate floors and other logically grouped activities.

D. Provide subschedules for each phase of Work identified in Section 011100.

E. Provide subschedules to define critical portions of the entire Progress Schedule.

F. Show accumulated percentage of completion of each item, and total percentage of Work completed, as of the first day of each month.

G. Provide separate schedule of submittal dates for Shop Drawings, Product Data, and Samples, including:
   1. Dates reviewed submittals will be required from Architect.
   2. Decision dates for selection of finishes.

H. Coordinate content with Schedule of Values specified in Section 012900.

I. Revisions:
   1. Indicate progress of each activity to date of submittal, and projected completion date of each activity.
   2. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes.

J. Provide narrative report to define problem areas, anticipated delays, and impact on Progress Schedule. Report corrective action taken, or proposed, and its effect.

1.4 SUBMITTAL
A. Submit initial Progress Schedule within 15 days after date of Notice to Proceed. After review, resubmit required revised data within 10 days.

B. Submit revised Progress Schedule with [each] [every other] Application for Payment.

C. Submit electronically in Adobe PDF format.

1.5 DISTRIBUTION

A. Distribute copies of approved Progress Schedule to project site file, Subcontractors, suppliers, and other concerned parties.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in Progress Schedule.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Submittal procedures.
   2. Proposed Products list.
   3. Submittal schedule.
   4. Shop Drawings.
   5. Product Data.
   6. Samples.
   7. Quality control submittals.

B. Related Sections:
   1. Section 01 4000 - Quality Requirements.

1.2 SUBMITTAL PROCEDURES

A. Number each submittal with Project Manual section number and a sequential number within each section. Number resubmittals with original number and an alphabetic suffix.

B. Identify Project, Construction Manager, Subcontractor or supplier, pertinent Drawing sheet and detail numbers, and specification Section number, as appropriate.

C. Submit all submittals listed under “Submittals for Review” simultaneously for each Product or Specification Section.

D. Where multiple Products function as an assembly, group submittals for all related Products into single submittal.

E. Architect will not review incomplete submittals.

F. Apply Construction Manager's stamp, signed or initialed certifying that:
   1. Submittal was reviewed.
   2. Products, field dimensions, and adjacent construction have been verified.
   3. Information has been coordinated with requirements of Work and Contract Documents.

G. Schedule submittals to expedite the Project, and deliver to Architect. Coordinate submittal of related items.

H. For each submittal, allow 14 days for Architect’s review, excluding delivery time to and from Construction Manager.

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

J. Revise and resubmit submittals when required; identify all changes made since previous submittal.

K. Distribute copies of reviewed submittals to concerned parties and to Project Record Documents file. Instruct parties to promptly report any inability to comply with provisions.

1.3 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Notice to Proceed, submit a complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.
B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

C. Submit electronically in Adobe PDF format.

1.4 SUBMITTAL SCHEDULE

A. Within 15 days after date of Notice to Proceed, submit a submittal schedule showing all submittals proposed for project, including submittals listed as:
   1. Submittals for Review.
   2. Quality Control Submittals.
   3. Closeout Submittals.

B. Include for each submittal:
   1. Specification section number.
   2. Description of submittal.
   3. Type of submittal.
   4. Anticipated submittal date.
   5. For submittals requiring Architect’s review, date reviewed submittal will be required from Architect.

C. Submit electronically in Adobe PDF format.

1.5 SHOP DRAWINGS

A. Present information in clear and thorough manner.

B. Identify details by reference to sheet and detail numbers or room number shown on Drawings.

C. Reproductions of details contained in Contract Documents are not acceptable.

D. Submit electronically in Adobe PDF format. Architect will return one copy to CM in Adobe PDF format.

1.6 PRODUCT DATA

A. Mark each copy to identify applicable products, models, options, and other data.

B. Supplement manufacturers’ standard data to provide information unique to this Project.

C. Submit in Adobe PDF format. Architect will return one copy to CM in Adobe PDF format.

1.7 SAMPLES

A. Submit samples to illustrate functional and aesthetic characteristics of Products, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

B. Where so indicated, submit samples of finishes from the full range of manufacturers' standard colors, textures, and patterns for Architect's selection.

C. Include identification on each sample, with full Project information.

D. Unless otherwise specified in individual specifications, submit two of each sample.

E. Architect will notify Construction Manager of approval or rejection of samples, or of selection of color, texture, or pattern if full range is submitted.
1.8 QUALITY CONTROL SUBMITTALS

A. Quality control submittals specified in Section 01 4000 are for information and do not require Architect’s responsive action except to require resubmission of incomplete or incorrect information.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A. Section Includes:
   1. Patching and extending existing work.
   2. Transitions and adjustments.
   3. Repair of damaged surfaces.

B. Related Sections:
   1. Environmental Report – Southern Earth Sciences
   2. Section 07 8400 - Firestopping.

1.2  PROJECT CONDITIONS

A. Hazardous Materials:
   1. A survey of hazardous materials was performed by the Owner; a copy of the report is available for review at the Construction Manager’s office. Review report prior to commencement of work under this Contract.


PART 2  PRODUCTS

2.1  MATERIALS

A. New Materials:
   1. Provide new materials to match existing adjacent materials for closing of openings, repairs, and reconstructions where suitable salvaged materials do not exist, are insufficient in quantity, or where reuse is not permitted.
   2. Match existing materials in material, type, size, quality, color, finish, and other attributes.

B. Reused Materials:
   1. Clean and prepare salvaged materials for reuse.
   2. Do not use materials with objectionable chips, cracks, splits, dents, scratches, or other defects.
   3. Repair operable items to function properly.

PART 3  EXECUTION

3.1  PREPARATION

A. Test materials to be used in repairs for compatibility with existing materials; do not use incompatible materials.

B. Cut, move, or remove items as necessary for access to alterations and renovation work. Replace and restore upon completion.

C. Remove, cut, and patch work in manner to minimize damage and to provide means for restoring products and finishes to their original or specified new condition.

D. Remove unsuitable materials not marked for salvage.

E. Remove debris and abandoned items from areas of work and from concealed spaces.

3.2  ALTERATIONS
A. Coordinate alterations and renovations to expedite completion.

B. Install products and finish surfaces as specified in individual sections, or where no specification section exists to match existing.

C. Refinish visible surfaces to specified condition, with neat transition to adjacent surfaces.

D. Finish patches to provide uniform color and texture over entire surface, with repairs not discernible from normal viewing distance. If finish cannot be matched, refinish entire surface to nearest intersections.

E. Where removal of partitions or walls results in adjacent spaces becoming one, rework finished surfaces to smooth plane, without breaks, steps, or bulkheads.

F. Where new work abuts or aligns with existing, provide smooth and even transition. Where a change in plane of 1/4 inch or more occurs, submit recommendation to Architect for transition.

G. Where alterations expose mechanical and electrical components that were previously concealed, renovate to be concealed in completed work.

H. In addition to specified replacement of equipment and fixtures, restore mechanical and electrical systems to full operational condition.

I. Patch holes in exposed surfaces left by removal of mechanical and electrical components.

J. Existing Fire-Rated Assemblies:
   1. Patch or replace fire protection materials to maintain integrity of fire ratings.
   2. Seal penetrations through and perimeter of fire-rated assemblies under provisions of Section 07 8400.

END OF SECTION
SECTION 01 4000
QUALITY REQUIREMENTS

PART 1   GENERAL

1.1 SUMMARY

A. Section Includes:
   1. References.
   2. Quality assurance and control of installation.
   3. Mockups.
   4. Manufacturer’s field services and reports.
   5. Design data and calculations.
   6. Test reports and certifications.
   7. Manufacturer’s installation instructions.

1.2 REFERENCES

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

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

C. Conform to edition of reference standard in effect as of date of Owner/Construction Manager Agreement.

D. 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.

1.3 QUALITY ASSURANCE AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, Products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply fully with manufacturers’ instructions, including each step in sequence.

C. Should manufacturers’ instructions conflict with Contract Documents, request clarification from Architect before proceeding.

D. Comply with specified standards as a minimum quality for the Work except when more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform work by persons qualified to produce workmanship of specified quality.

F. Secure Products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion or disfigurement.

1.4 MOCKUPS

A. Definition:
   1. Mockups are field samples constructed, applied, or assembled at the project site for review by the Owner and Architect that illustrate materials, equipment, or workmanship.
   2. Approved mockups establish the standard of quality by which the Work will be judged.

B. Construct, apply, or assemble specified items, with related attachment and anchorage devices, flashings, seals, and finishes.
C. Perform work in accordance with applicable specifications sections.

D. Erect at project site at location acceptable to Architect. Protect from damage.

E. Removal:
   1. Mockups may remain as part of the Work only when so designated in individual specification sections.
   2. Do not remove mockups until removal is approved by Architect or upon Final Completion.
   3. Where mockup is not permitted to remain as part of the Work, clear area after removal of mockup has been approved by Architect.

1.5 MANUFACTURERS’ FIELD SERVICES AND REPORTS

A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, or startup of equipment, as applicable, and to initiate instructions when necessary.

B. Individuals to report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers’ written instructions.

C. Submit report to Architect within 10 days of observation.

1.6 DESIGN DATA AND CALCULATIONS

A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide design data and calculations.

B. Accuracy of design data and calculations is the responsibility of the Construction Manager.

C. When so specified, prepare design data and calculations under the direction of a professional engineer licensed in the state in which the Project is located. Affix engineer's seal to submittals.

D. Submit electronically in Adobe PDF format.

1.7 TEST REPORTS AND CERTIFICATIONS

A. When specified in individual specification Sections, require material or Product suppliers or manufacturers to provide test reports and manufacturers’ certifications.

B. Indicate that material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Submittals may be recent or previous test results on material or Product, but must be acceptable to Architect.

D. Submit electronically in Adobe PDF format.

1.8 MANUFACTURER’S INSTALLATION INSTRUCTIONS

A. When Contract Documents require that Products be installed in accordance with manufacturer's instructions:
   1. Submit manufacturer's most recent printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, as applicable.
      a. Submit in quantities specified for Product Data.
      b. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.
      c. Identify conflicts between manufacturers’ instructions and requirements of Contract Documents.
   2. Perform installation of Products to comply with requirements of manufacturer's instructions.
3. If installation cannot be performed in accordance with manufacturer's instructions, notify Architect and await instructions.
4. Submit electronically in Adobe PDF format.

PART 2   PRODUCTS
Not used

PART 3   EXECUTION
Not used

END OF SECTION
SECTION 01 4523
TESTING AND INSPECTION SERVICES

GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Laboratory selection and payment.
   2. Laboratory duties.
   3. Contractor’s responsibilities.

B. Related Sections: Individual specifications sections contain specific tests and inspections to be performed.

1.2 REFERENCES

A. ASTM International (ASTM):

1.3 QUALITY ASSURANCE

A. Contractor shall employ and pay for services of an independent testing laboratory to perform specified testing and inspection.

B. Employment of Testing Laboratory shall in no way relieve Contractor of his obligations to perform work in accordance with Contract Documents.

C. Refer to the Conditions of the Contract for provisions related to special inspections and testing.

D. Qualifications of Laboratory:
   1. Meet requirements of applicable ASTM standards.
   2. Authorized to operate in State in which project is located.

1.4 LABORATORY DUTIES

A. Cooperate with Architect and Contractor; provide qualified personnel after due notice.

B. Perform specified inspections, sampling, and testing of materials and methods of construction:
   1. Comply with specified standards.
   2. Ascertain compliance or noncompliance of materials with requirements of Contract Documents.

C. Promptly notify Architect and Contractor of observed irregularities or deficiencies of Work or products.

D. Promptly submit written report of each test and inspection; submit electronically in Adobe PDF format to Architect, Owner, and Contractor.

E. Each report to include:
   1. Date issued.
   2. Project title and number.
   3. Testing Laboratory name, address, and telephone number.
4. Name of Inspector and signature of individual in charge.
5. Date and time of sampling or inspection.
6. Record of temperature and weather conditions.
7. Date of test.
8. Identification of product and specification section.
9. Location of sample or test in project.
10. Type of inspection or test.
11. Results of tests and compliance or noncompliance with Contract Documents.
12. Interpretation of test results when requested by Architect or Contractor.

F. Perform additional tests when required by Architect or Contractor.

G. Laboratory is not authorized to:
   1. Release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Approve or accept any portion of work.
   3. Perform any duties of Contractor.

1.5 CONTRACTOR'S RESPONSIBILITIES

A. Cooperate with Laboratory personnel, provide access to Work, and to manufacturer's operations.

B. When materials require testing prior to being incorporated into Work, secure and deliver to Laboratory adequate quantities of representative samples of materials proposed to be used.

C. Furnish copies of product test reports as required.

D. Furnish incidental labor and facilities:
   1. To provide access to work to be tested.
   2. To obtain and handle samples at site or at source of product to be tested.
   3. To facilitate inspections and tests.
   4. For safe storage and curing of test samples.

E. Notify Laboratory sufficiently in advance of operations to allow for Laboratory assignment of personnel and scheduling of tests.

F. When tests or inspections cannot be performed after such notice, reimburse Owner for Laboratory personnel and travel expenses incurred due to Contractor's negligence.

G. Make arrangements with Laboratory and pay for additional samples and tests required for Contractor's convenience.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A.  Section Includes:
1.  Temporary utilities.
2.  Field offices and sheds.
3.  Temporary controls.
4.  Protection of installed Work.
6.  Progress cleaning.
7.  Water, erosion, sediment, dust, and mold and mildew control.
8.  Access roads and parking areas.

1.2  REFERENCES

A.  Green Seal, Inc. (GS) 37 - Environmental Standard for Industrial and Institutional Cleaners.

PART 2  PRODUCTS

Not used

PART 3  EXECUTION

3.1  TEMPORARY ELECTRICITY

A.  Provide temporary electrical service of capacity and characteristics required for construction.

B.  Connect to existing electrical system for electricity required during construction.
   1.  Cost of electricity used will be paid for by Owner. Exercise measures to conserve electricity.
   2.  Regulate system to prevent interference with Owner's normal usage.
   3.  Maintain continuous power operation of Owner’s facilities during changeover of electrical services.
   4.  Notify Owner when unusually heavy loads will be connected, including welding and other equipment with special power requirements.
   5.  Provide and pay for required service of capacity or characteristics other than that currently available.

C.  Provide power outlets for construction operations, with branch wiring and distribution boxes located as required. Provide flexible power cords as required.

D.  Maintain distribution system and provide routine repairs.

3.2  TEMPORARY LIGHTING

A.  Provide temporary lighting for construction and security purposes.

B.  Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as required.

C.  Maintain lamps and provide routine repairs.

D.  Provide portable lights when required to provide minimum lighting levels necessary for specific work.
3.3 TEMPORARY HEAT

A. Provide temporary heating devices required to maintain specified ambient temperatures for construction.

B. Utilize existing facilities for heat required during construction.
   1. Extend and supplement with temporary heat devices required to maintain specified ambient temperatures for construction.
   2. Costs of fuel used from existing facilities will be paid for by Owner. Exercise measures to conserve fuel.

C. Maintain minimum ambient temperature of 50 degrees F in areas where construction is in progress, unless otherwise indicated in individual specification sections.

3.4 TEMPORARY VENTILATION

A. Ventilate enclosed areas to facilitate curing of materials, disperse humidity, and prevent accumulations of dust, fumes, vapors, or gases.

B. Provide temporary fan units as required to maintain clean air for construction.

C. Utilize existing ventilation equipment. Extend and supplement with temporary fan units as required to maintain clean air for construction.

3.5 TEMPORARY TELEPHONE, FACSIMILE, AND COMPUTER SERVICES

A. Contractor shall be accessible during normal business hours via mobile telephone with voice mail or an answering service.

3.6 TEMPORARY WATER

A. Provide temporary water required for construction.

B. Connect to existing water source for water required for construction.
   1. Regulate system to prevent interference with Owner's usage.
   2. Costs of water used will be paid for by Owner. Exercise measures to conserve water.

C. Extend branch piping and provide temporary hoses so that water is available at locations needed for work.

D. Protect from freezing.

E. Maintain distribution system and provide routine repairs.

3.7 TEMPORARY SANITARY FACILITIES

A. Provide chemical toilets for use during construction.

B. Existing toilets may not be used during construction.

C. Permanent toilets may not be used during construction.

D. Maintain facilities in clean and sanitary condition.

3.8 FIELD OFFICES AND SHEDS

A. Provide temporary field offices and storage sheds required for construction.

B. Existing building may not be used for field office and storage of materials.
C. Do not unreasonably encumber site or premises with excess materials or equipment.

D. Temporary Structures:
   1. Portable or mobile buildings, structurally sound, weathertight, with floors raised above ground.
   2. Thermal transmission resistance: Compatible with occupancy and storage requirements.
   3. Provide connections for utility services when required.
   4. Provide steps and landings at entrances.

E. Field Office:
   1. Size required for Contractor’s use and to provide space for project meetings.
   2. Adequate electrical power, lighting, heating, and cooling to maintain human comfort.
   3. Provide facilities for storage of Project Record Documents.
   4. Provide thermometer mounted at convenient outside location, not in direct sunlight.

3.9 BARRIERS

A. Provide barriers to prevent unauthorized entry to construction areas, to allow Owner’s use of site and premises, and to protect existing facilities and adjacent properties from construction operations.

B. Provide barricades required by governing authorities for public right-of-ways and for public access to existing facilities.

C. Fencing:
   1. Provide temporary fencing for construction operations.
   2. Construction: Commercial grade chain link.
   3. Height: 6 feet.
   4. Locate to protect construction operations, materials, and equipment.
   5. Provide vehicular and pedestrian gates.

D. Tree and Plant Protection:
   1. Protect existing trees and plants at site that are designated to remain.
   2. Do not permit vehicular traffic, parking, storage of materials, dumping of harmful chemicals or liquids, or standing or continuously running water within root zones.
   3. Supervise earthwork operations to prevent damage to root zones.
   4. Replace trees and plants that are damaged or destroyed due to construction operations.

3.10 EXTERIOR CLOSURES

A. Provide temporary weathertight closures for exterior openings to provide acceptable interior working conditions, to allow for temporary heating and maintenance of ambient temperatures required in individual specification sections, to protect the Work, and to prevent entry of unauthorized persons.

B. Provide access doors with locking hardware.

3.11 TEMPORARY PARTITIONS

A. Provide temporary partitions to separate work areas from occupied areas of building, prevent penetration of dust and moisture into occupied areas, and protect Owner’s employees, equipment, and operations from construction activities.
   1. Construction: Wood or Metal framing with reinforced polyethylene covering on Owner occupied side.
   2. Close joints between sheet materials and seal edges and intersections to prevent penetration of dust and moisture.
   3. In locations where fire protection is required, use fire retardant materials or paint with fire retardant paint to provide fire hazard ratings required by applicable codes and regulations.
   4. Paint surfaces exposed to view in Owner occupied areas.

3.12 PROTECTION OF INSTALLED WORK
A. Protect installed work from construction operations; provide special protection when required in individual specification sections.

B. Minimize traffic, storage, and construction activities on roof surfaces. If traffic, storage, or activity is necessary, obtain recommendations for protection from roofing manufacturer.

C. Prohibit traffic from landscaped areas.

3.13 PROGRESS CLEANING

A. Maintain areas free from waste materials, debris, and rubbish. Maintain site in clean and orderly condition.

B. Provide containers for collection of waste materials, debris, and rubbish; remove and dispose of off site as required by construction activities.

C. Periodically clean interior areas to provide suitable conditions for finish work.

3.14 TEMPORARY CONTROLS

A. Dust Control:
   1. Provide dust control materials and methods to minimize dust from construction operations.
   2. Prevent dust from dispersing into atmosphere.

B. Mold and Mildew Control:
   1. Provide continuous measures to prevent formation of mold and mildew in construction.
   2. Do not install materials sensitive to mold and mildew growth until protection can be provided.
   3. Promptly remove and replace materials exhibiting mold and mildew growth.

3.15 ACCESS ROADS AND PARKING AREAS

A. Existing roads designated by Owner may be used for construction purposes. Do not allow heavy vehicles or construction equipment in parking areas.

B. Provide for access by emergency vehicles.

C. Keep fire hydrants and water control valves free from obstruction and accessible for use.

D. Provide parking facilities for construction personnel. When parking needs exceed on site capacity, provide additional off site facilities.

E. Maintain existing construction, and restore to original or specified condition at completion of Work.

3.16 REMOVAL

A. Remove temporary utilities, equipment, facilities, and services when construction needs can be met by use of permanent construction or upon completion of Project.

B. Remove foundations and underground installations; grade site as indicated.

C. Clean and repair damage caused by installation or use of temporary work.

D. Restore existing and permanent facilities used during construction to original or to specified condition.

END OF SECTION
SECTION 01600
PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for selecting products for use in Project; product delivery, storage, and handling; manufacturers’ standard warranties on products; special warranties; product substitutions; and comparable products.

B. See Division 1 Section "Closeout Procedures" for submitting warranties for contract closeout.

C. See Divisions 2 through 16 Sections for specific requirements for warranties on products and installations specified to be warranted.

1.2 DEFINITIONS

A. Products: Items purchased for incorporating into the Work, whether purchased for Project or taken from previously purchased stock. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.

1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation, shown or listed in manufacturer's published product literature, that is current as of date of the Contract Documents.

2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.

3. Comparable Product: Product that is demonstrated and approved through submittal process, or where indicated as a product substitution, to have the indicated qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.

C. Basis-of-Design Product Specification: Where a specific manufacturer's product is named and accompanied by the words "basis of design," including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of other named manufacturers.
D. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.

E. Special Warranty: Written warranty required by or incorporated into the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.

1.3 SUBMITTALS

A. Substitution Requests: Submit three copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   a. Documentation: Show compliance with requirements for substitutions.
   b. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within one week of receipt of a request for substitution. Architect will notify Contractor of acceptance or rejection of proposed substitution within 7 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 1 Section "Submittal Procedures." Show compliance with requirements.

1.4 QUALITY ASSURANCE

A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, product selected shall be compatible with products previously selected, even if previously selected products were also options.

1.5 PRODUCT WARRANTIES

A. Warranties specified in other Sections shall be in addition to, and run concurrent with, other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 PRODUCT OPTIONS

A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.

B. Product Selection Procedures: Procedures for product selection include the following:
1. Product: Where Specification paragraphs or subparagraphs titled "Product" name a single product and manufacturer, provide the product named.
   a. Substitutions may be considered unless otherwise indicated.

2. Manufacturer/Source: Where Specification paragraphs or subparagraphs titled "Manufacturer" or "Source" name single manufacturers or sources, provide a product by the manufacturer or from the source named that complies with requirements.
   a. Substitutions may be considered, unless otherwise indicated.

3. Products: Where Specification paragraphs or subparagraphs titled "Products" introduce a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   a. Substitutions may be considered unless otherwise indicated.

4. Manufacturers: Where Specification paragraphs or subparagraphs titled "Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   a. Substitutions may be considered, unless otherwise indicated.

5. Available Products: Where Specification paragraphs or subparagraphs titled "Available Products" introduce a list of names of both products and manufacturers, provide one of the products listed or another product that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

6. Available Manufacturers: Where Specification paragraphs or subparagraphs titled "Available Manufacturers" introduce a list of manufacturers' names, provide a product by one of the manufacturers listed or another manufacturer that complies with requirements. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.

7. Basis-of-Design Products: Where Specification paragraphs or subparagraphs titled "Basis-of-Design Product" are included and also introduce or refer to a list of manufacturers' names, provide either the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in "Comparable Products" Article to obtain approval for use of an unnamed product.
   a. Substitutions may be considered, unless otherwise indicated.

8. Visual Selection Specification: Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product (and manufacturer) that complies with other specified requirements.
   a. Standard Range: Where Specifications include the phrase "standard range of colors, patterns, textures" or similar phrase, Architect will select color,
pattern, or texture from manufacturer’s product line that does not include premium items.

b. Full Range: Where Specifications include the phrase "full range of colors, patterns, textures" or similar phrase, Architect will select color, pattern, or texture from manufacturer’s product line that includes both standard and premium items.

2.2 PRODUCT SUBSTITUTIONS

A. Timing: Architect will consider requests for substitution if received within 60 days after the Notice of Award. Requests received after that time may be considered or rejected at discretion of Architect.

B. Conditions: Architect will consider Contractor’s request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:

1. Requested substitution offers Owner a substantial advantage in cost, time, energy conservation, or other considerations, after deducting additional responsibilities Owner must assume. Owner’s additional responsibilities may include compensation to Architect for redesign and evaluation services, increased cost of other construction by Owner, and similar considerations.
2. Requested substitution does not require extensive revisions to the Contract Documents.
3. Requested substitution is consistent with the Contract Documents and will produce indicated results.
4. Substitution request is fully documented and properly submitted.
5. Requested substitution will not adversely affect Contractor’s Construction Schedule.
6. Requested substitution has received necessary approvals of authorities having jurisdiction.
7. Requested substitution is compatible with other portions of the Work.
8. Requested substitution has been coordinated with other portions of the Work.
9. Requested substitution provides specified warranty.

2.3 COMPARABLE PRODUCTS

A. Where products or manufacturers are specified by name, submit the following, in addition to other required submittals, to obtain approval of an unnamed product:

1. Evidence that the proposed product does not require extensive revisions to the Contract Documents, that it is consistent with the Contract Documents and will produce the indicated results, and that it is compatible with other portions of the Work.
2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
3. Evidence that proposed product provides specified warranty.
4. List of similar installations for completed projects with project names and addresses and names and addresses of architects and owners, if requested.
5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000
SECTION 01 7329
CUTTING AND PATCHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Requirements and limitations for cutting and patching of work.

B. Related sections:
   1. Section 01 2500 - Substitution Procedures.

1.2 SUBMITTALS

A. Submit written request in advance of executing cutting or alteration that affects:
   1. Work of Owner or separate contractor.
   2. Structural integrity of project.
   3. Integrity or effectiveness of weather exposed or moisture resistant elements or systems.
   4. Efficiency, operational life, maintenance, or safety of operational elements.
   5. Visual qualities of sight exposed elements.

B. Include in Request:
   1. Identification of project.
   2. Description of work affected.
   3. Necessity for cutting or patching.
   4. Effect of cutting or patching on work of Owner or separate contractor, or on structural, weatherproof, or visual integrity of project.
   5. Description of proposed work:
      a. Scope of cutting and patching.
      b. Subcontractor and trades to execute work.
      c. Products proposed to be used.
      d. Extent of refinishing.
   6. Alternate to cutting and patching.
   7. Cost proposal, if applicable.
   8. Written permission of any separate contractor whose work will be affected.

C. If conditions of work or schedule necessitate a change of material from that originally installed, submit substitution request in accordance with Section 01 2500.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

3.1 PREPARATION

A. Examine existing conditions of work, including elements subject to movement or damage during cutting and patching.

B. After uncovering work, examine conditions affecting installation of new products or performance of work.

C. Provide protection for other portions of project.

D. Provide protection from elements.

3.2 CUTTING AND PATCHING
A. Execute cutting to include excavating, fitting, and patching of Work required to:
   1. Make several parts fit properly.
   2. Uncover work to provide for installation of ill timed work.
   3. Remove and replace defective work.
   4. Remove and replace work not conforming to requirements of Contract Documents.
   5. Provide routine penetrations of nonstructural surfaces for installation of piping and electrical conduit.

B. Execute fitting and adjustment of products to provide finished installation to comply with specified tolerances, and finishes.

C. Execute cutting and demolition by methods that will prevent damage to other work, and will provide proper surfaces to receive installation of repairs and new work.

D. Execute excavating and backfilling by methods that will prevent damage to other Work, and will prevent settlement.

E. Employ original installer or fabricator to perform cutting and patching for:
   1. Weather exposed or moisture resistant elements.
   2. Sight exposed finished surfaces.

F. Restore work that has been cut or removed; install new products to provide completed Work in accordance with requirements of Contract Documents.

G. Refinish entire surfaces as necessary to provide an even finish:
   1. Continuous surfaces: To nearest intersections.
   2. Assembly: Refinish entirely.

END OF SECTION
PART 1  GENERAL

1.1  SUMMARY

A. Section Includes:
   1. Closeout procedures.
   2. Final cleaning.
   3. Adjusting.
   4. Project record documents.
   5. Operation and maintenance data.
   7. Spare parts and maintenance materials.
   8. Starting of systems.
   9. Demonstration and instructions.

1.2  CLOSEOUT PROCEDURES

A. Final Inspection:
   1. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with the Contract Documents and ready for Architect's inspection.
   2. If Architect performs reinspection due to failure of Work to comply with claims of status of completion made by Construction Manager, Owner will compensate Architect for such additional services and will deduct the amount of such compensation from final payment to Construction Manager.

B. Submit final Application for Payment showing original Contract Sum, adjustments, previous payments, retainage withheld from previous payments, and sum remaining due.

C. Closeout Submittals:
   1. Evidence of compliance with requirements of governing authorities.
   3. Project Record Documents.
   4. Operation and Maintenance Data.
   5. Warranties.
   7. Spare parts and maintenance materials.
   8. Evidence of payment of Subcontractors and suppliers.
   10. Certificate of insurance for products and completed operations.
   11. Consent of Surety to final payment.

D. Owner will occupy portions of the building during construction.

1.3  FINAL CLEANING

A. Execute final cleaning prior to final inspection.

B. Clean surfaces exposed to view:
   1. Clean glass.
   2. Remove temporary labels, stains and foreign substances.
   3. Polish transparent and glossy surfaces.

C. Clean equipment and fixtures to a sanitary condition.
D. Clean or replace filters of operating equipment.

E. Remove waste and surplus materials, rubbish, and construction facilities from the site.

1.4 ADJUSTING

A. Adjust operating Products and equipment to ensure smooth and unhindered operation.

1.5 PROJECT RECORD DOCUMENTS

A. Maintain following record documents on site; record actual revisions to the Work:
   1. Drawings.
   2. Specifications.
   3. Addenda.
   4. Change Orders and other Modifications to the Contract.
   5. Reviewed Shop Drawings, Product Data, and Samples.

B. Store Record Documents separate from documents used for construction.

C. Record information concurrent with construction progress.

D. Make entries neatly and accurately.

E. Label each set or volume with title "PROJECT RECORD DOCUMENTS", project title, and description of contents.
   1. Organize contents according to Project Manual table of contents.
   2. Provide table of contents for each volume.

F. Drawings: Mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finish floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
   4. Field changes of dimension and detail.
   5. Details not on original Drawings.

G. Specifications: Mark each Product section description of actual Products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by Addenda and Modifications.

H. Shop Drawings: Mark each item to record actual construction including:
   1. Field changes of dimension and detail.
   2. Details not on original Shop Drawings.

I. Submit electronically in Adobe PDF format.

1.6 OPERATION AND MAINTENANCE DATA

A. Identify as "OPERATION AND MAINTENANCE INSTRUCTIONS" and title of project.

B. Contents:
   1. Directory: List names, addresses, and telephone numbers of Architect, Construction Manager, Subcontractors, and major equipment suppliers.
2. Operation and maintenance instructions: Arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
   a. Significant design criteria.
   b. List of equipment.
   c. Parts list for each component.
   d. Operating instructions.
   e. Maintenance instructions for equipment and systems.
   f. Maintenance instructions for special finishes, including recommended cleaning methods and materials and special precautions identifying detrimental agents.

3. Project documents and certificates including:
   a. Shop drawings and product data.
   b. HVAC balance reports.
   c. Certificates.
   d. Copies of warranties and bonds.

C. Submittal:
   1. Submit electronically in Adobe PDF format at least 15 days prior to final inspection.
   2. Architect will notify Construction Manager of any required revisions after final inspection.
   3. Revise content of documents as required prior to final submittal.
   4. Submit revised documents electronically in Adobe PDF format within 10 days after final inspection.

1.7 WARRANTIES

A. Execute and assemble documents from Subcontractors, suppliers, and manufacturers.

B. Include Table of Contents.

C. Submit electronically in Adobe PDF format along with final Application for Payment.

D. For items of Work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.

1.8 SPARE PARTS AND MAINTENANCE MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual specification Sections.

B. Deliver to Project site in location as directed; obtain receipt prior to final payment.

1.9 STARTING OF SYSTEMS

A. Notify Owner and Architect at least seven days prior to startup of each system or piece of equipment.

B. Prior to beginning startup verify that:
   1. Lubrication has been performed.
   2. Drive rotation, belt tension, control sequences, tests, meter readings, and electrical characteristics are within manufacturer's requirements.
   3. Utility connections and support components are complete and tested.

C. Execute start-up under supervision of applicable manufacturer's representative or Construction Manager's personnel in accordance with manufacturers' instructions.

D. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to startup, and to supervise placing equipment or system in operation.

E. Submit written report that equipment or system has been properly installed and is functioning correctly.
1.10 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of Products to Owner's personnel two weeks prior to date of Substantial Completion.

B. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

C. Utilize Operation and Maintenance Manuals as basis for instruction. Review contents of manual with Owners' personnel in detail to explain all aspects of operation and maintenance.

D. Demonstrate startup, operation, control, adjustment, troubleshooting, servicing, maintenance, and shutdown of each item of equipment at agreed upon times, at equipment location.

E. Prepare and insert additional data in Operation and Maintenance Manuals when need for additional data becomes apparent during instruction.

PART 2 PRODUCTS

Not used

PART 3 EXECUTION

Not used

END OF SECTION
SECTION 02 4120
BUILDING DEMOLITION

PART 1    GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Removal of designated building construction, equipment, and fixtures.
   2. Identification of utilities.
B. Related Sections:
   1. Division 01 - Administrative, procedural, and temporary work requirements.

1.2 SUBMITTALS
A. Submittals for Review:
   1. Shop Drawings: Indicate areas for demolition, removal sequence and location of salvageable items, and location and construction of temporary work.

1.3 REGULATORY REQUIREMENTS
A. Conform to applicable code for demolition work, safety of structure, and dust control.
B. Obtain required permits from authorities.
C. Notify affected utility companies before starting work and comply with their requirements.
D. Conform to applicable codes when hazardous or contaminated materials are discovered.
E. Do not close or obstruct exits.
F. Do not disable or disrupt building fire or life safety systems without 3 days prior written notice to Owner.

1.4 PROJECT CONDITIONS
A. Minimize interference with streets, walks, public right-of-ways, and adjacent facilities.
B. If hazardous materials are discovered, notify Architect and await instructions.
C. If any of the following conditions are encountered, cease work immediately, notify Architect, and await instructions:
   1. Structure is in danger of movement or collapse.
   2. Materials or conditions encountered differ from those designated in the Contract Documents.

PART 2    PRODUCTS
Not used

PART 3    EXECUTION

3.1 PREPARATION
A. Erect temporary partitions, barricades, warning devices, and controls.
B. Provide protective coverings, shoring, bracing, and supports for construction designated to remain.
C. Temporarily or permanently disconnect utilities as required.

3.2 DEMOLITION

A. Remove existing construction to extent indicated and as necessary to join new work to existing. Do not remove more than is necessary to allow for new construction.

B. Do not damage work designated to remain.

C. Minimize noise and spread of dirt and dust.

D. Assign work to trades skilled in procedures involved.

E. Plug ends of disconnected utilities with threaded or welded caps.

F. Protect and support active utilities designated to remain. Post warning signs showing location and type of utility and type of hazard.

G. Store items designated to remain property of Owner where directed by Owner.

H. Remove and dispose of waste materials off site.

END OF SECTION
SECTION 04 2000
UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Concrete unit masonry.
   2. Brick unit masonry.
   3. Integral flashings.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 07 9200 - Joint Sealers.

C. Allowances:
   1. Include a unit cost allowance of $550 per 1000 brick for purchase of brick only.
   2. Installation is not included in amount of allowance, and is to be included in Contract Sum.

1.2 REFERENCES

A. ASTM International (ASTM):
   2. A615/A615M - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   3. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
   4. A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
   7. C90 - Standard Specification for Hollow Loadbearing Concrete Masonry Units.

B. The Masonry Society (TMS):

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Provide information on reinforcing and anchors including sizes, profiles, materials, and finishes.
   2. Samples: Brick samples in quantities showing full color and texture range.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 10 years experience in work of this Section.

1.5 DELIVERY, STORAGE AND HANDLING
A. Store masonry off ground; prevent contact with materials that could cause staining or damage.
B. Protect reinforcement and anchors from corrosion.

1.6 PROJECT CONDITIONS

A. Wall Protection:
   1. During erection, cover tops of partially completed walls with strong waterproof membrane at end of each day or work stoppage.
   2. Extend cover minimum of 24 inches down both sides; hold securely in place.

B. Load Application:
   1. Do not apply uniform loads for at least 12 hours after building masonry columns or walls.
   2. Do not apply concentrated loads for at least 3 days after building masonry columns or walls.

C. Environmental Requirements:
   1. Hot weather requirements: If ambient temperature is over 95 degrees F or relative humidity is less than 50 percent, protect from direct sun and wind exposure for minimum 48 hours after installation.
   2. Cold weather requirements: Do not use frozen materials or build on frozen work.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Masonry Accessories:
   1. Blok-Lok Ltd. ([www.blok-lok.com])
   2. Dur-O-Wal. ([www.dur-o-wal.com])
   3. Heckmann Building Products. ([www.heckmannbuildingprods.com])
   4. Hohmann and Barnard, Inc. ([www.h-b.com])

2.2 MATERIALS

A. Concrete Masonry Units:
   1. ASTM C90, hollow load bearing type, normal weight.
   2. Size: Nominally 8 inches high x 16 inches long x 8 inches thick.

B. Face Brick: To be selected under an allowance.

2.3 ACCESSORIES

A. Single Wythe Joint Reinforcement:
   1. Truss type; ASTM A951, hot-dip galvanized steel wire, 9 gage side rods with 9 gage cross ties.
   2. Corner and tee fittings: Type to match reinforcement.

B. Double Wythe Joint Reinforcement:
   1. Truss type; ASTM A951, hot-dip galvanized steel wire, 9 gage side rods with 9 gage cross ties.
   2. Corner and tee fittings: Type to match reinforcement.

C. Veneer Ties: Formed steel wire, 3/16 inch thickness, two piece adjustable type with backing plate, hot dip galvanized, ASTM A153/A153M, minimum 2 inch embedment into masonry.

D. Fasteners: Hot-dip galvanized or Fluoropolymer coated steel screws, minimum 3/4 inch penetration into substrate.

E. Reinforcing Bars:
1. ASTM A615/A615M, deformed billet steel, Grade 4060.

F. Flashings: Polyvinyl chloride sheet, min. 30 mils thick.

G. Weeps: Preformed plastic mesh.

H. Mortar Dropping Control: Preformed plastic mesh.

I. Joint Sealer: Specified in Section 07 9200.

J. Cleaner: Type recommended by masonry manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

A. Wet brick having an absorption rate in excess of 20 g per 30 square inches per minute as determined by ASTM C67 so that absorption rate when laid does not exceed this amount.

B. Remove dirt, loose rust, and other foreign matter from reinforcement and anchors.

3.2 INSTALLATION

A. Establish lines, levels and courses indicated. Protect from displacement.

B. Maintain masonry courses to uniform dimensions. Form horizontal and vertical joints of uniform thickness.

C. Lay concrete masonry in running bond. Course one masonry unit and one mortar joint to equal 8 inches.

D. Lay brick masonry in running bond unless otherwise indicated. Course three brick units and three mortar joints to equal 8 inches.

E. Lay masonry plumb and level. Do not adjust masonry units after mortar has set.

F. Lay solid masonry units in full mortar bed, with full head joints. Lay hollow masonry units with face shell bedding on head and bed joints.

G. Do not butter corners or excessively furrow joints.

H. Machine cut masonry with straight cuts and clean edges; prevent oversized or undersized joints. Discard damaged units. Do not expose cut cells.

I. Isolate masonry from structural members with compressible filler.

J. When joining fresh masonry to partially set masonry, remove loose masonry and mortar; clean and lightly wet exposed surface of set masonry.

K. Stop horizontal runs by racking back normal bond unit in each course. Tooothing not permitted.

L. Horizontal Reinforcement:
   1. Place reinforcement at maximum 16 inches on center vertically, at topmost course, and at first two courses above and below openings.
   2. Extend minimum 24 inches each side of openings.
   3. Center reinforcing in wall.
   4. Lap ends 6 inches minimum; use fabricated tee and corner fittings at corners and intersections.

M. Secure masonry to structural members with strap anchors spaced maximum 16 inches on center.
N. Veneer Ties:
1. Space ties to provide one tie per 1.77 square feet at maximum spacing of 16 inches on center horizontally.
2. Locate ties within 12 inches of ends of masonry walls and openings.

O. Control and Expansion Joints:
1. Do not continue horizontal joint reinforcement through joints.
2. Keep joints free from mortar and grout.
3. Install joint backing and joint sealer at control joints in accordance with Section 07 9200.
4. Form expansion joint as indicated on Drawings.

P. Finishing Mortar Joints:
1. Exposed locations: Tool joints to concave profile.
2. Concealed locations: Cut joints flush.

Q. Reinforcing Bars:
1. Position reinforcing accurately and hold securely in place to prevent displacement. Maintain minimum 1" space between masonry and reinforcing.
2. Grout at intervals per structural drawings.
3. Vibrate grout during and after placement to ensure complete filling.
4. Stop grout 1-1/2 inch below top of masonry if grouting is stopped for 1 hour or more, except where completing grouting of finished wall.

R. Flashings:
1. Install flashing with outer edge flush with outside face of masonry; extend up backup 12 inches minimum and seal.
2. Lap end joints 4 inches minimum and seal.
3. Form end dams where flashing is stopped or interrupted.

S. Weeps:
1. Locate in head joints in first course above flashings at maximum 24 inches on center.
2. Set weeps flush with exterior face of masonry.

T. Install mortar dropping control continuously in cavities above flashings.

U. Installation Tolerances; Maximum variation from:
1. Alignment of columns and pilasters: Plus or minus 1/4 inch.
2. Alignment face to face of adjacent units: Plus or minus 1/8 inch.
3. Vertical alignment of head joints: Plus or minus 1/2 inch in 10 feet.
4. True plane of wall: Plus or minus 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
5. Plumb: Plus or minus 1/4 inch in 10 feet noncumulative; 1/2 inch in 20 feet or more.
6. Level coursing: Plus or minus 1/8 inch in 3 feet; 1/4 inch in 10 feet; 1/2 inch in 30 feet.
7. Joint thickness: Plus or minus 1/8 inch.
8. Cross sectional thickness of walls: Plus or minus 1/4 inch.

3.3 FIELD QUALITY CONTROL

A. Testing and Inspection Services:
1. Masonry units: Inspect masonry units prior to and during installation for compliance with specified requirements.
2. Masonry assemblies:
   a. Determine compressive strength of masonry by the prism method, ASTM C1314.
   b. Verify dimensions and condition of grout spaces and type, quantity, and placement of reinforcement during installation and just prior to closing of cleanouts.
   c. Verify type, quantity, and installation of reinforcement, anchors, and ties.
   d. Inspect placement of grout.
3. Grout: Mold and test one set of compressive strength cubes in accordance with ASTM C1019 for each 200 square feet of masonry wall area or fraction thereof.
3.4 CLEANING

A. Protect adjacent and underlying surfaces.

B. Apply masonry cleaner in accordance with manufacturer's instructions.

C. Thoroughly rinse surfaces with clean water after completion of cleaning; remove all traces of cleaning solution.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Non-load-bearing steel stud wall framing.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. American Iron and Steel Institute (AISI) www.steel.org - Specification for the Design of Cold-Formed Steel Structural Members.


C. ASTM International (ASTM) www.astm.org:
   1. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
   3. A1003/A1003M - Standard Specification for Steel Sheet, Carbon, Metallic- and Nonmetallic-Coated for Cold-Formed Framing Members.

D. Steel Stud Manufacturer’s Association (SSMA) www.ssma.com - Member Directory.


1.3 SUBMITTALS

A. Submittals for Review:
   2. Product Data: Indicate framing components, sizes, materials, finishes, and accessories.

1.4 QUALITY ASSURANCE

A. Manufacturer: Current member of SSMA.

B. Installer Qualifications: Minimum 10 years experience in work of this Section.

C. Design system to accommodate construction tolerances, deflection of building structural members, and clearances at openings.

1.5 DELIVERY, STORAGE AND HANDLING

A. In accordance with ASTM C1007.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Allsteel and Gypsum Products, Inc. (www.allsteelproducts.com)
2.2 MATERIALS

A. Framing Materials:
   1. ASTM A653/A653M or A1003/A1003M, galvanized sheet steel, G60 coating class.
   2. Fabricate components to ASTM C955.
   3. Studs: SSMA stud profile, C-shaped, punched for utility access.
   4. Tracks:
      a. SSMA stud track profile, C-shaped, same gage and depth as studs, unpunched.
      b. Top track: Deflection type, deep leg track with slotted screw holes; permit plus or minus 1/2 inch movement of overhead structure without damage to framing.
      c. Top and bottom track: 1-1/4 inch high legs.

2.3 ACCESSORIES

A. Bracing, Furring, Bridging and Web Stiffeners: Formed sheet steel, thickness determined by performance requirements specified.

B. Plates, Gussets, Clips: Formed sheet steel, thickness determined by performance requirements specified.

C. Fasteners: ASTM C1513; self-drilling, self-tapping screws.

D. Touch Up Paint: SSPC Paint 20, Type I or II.

2.4 FABRICATION

A. Cut members square and with tight fit to adjacent framing.

B. Assemble components using screw connection.

C. Fabricate straight, level, and true, without warp or rack.

D. Fabrication Tolerances: In accordance with ASTM C955.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Install framing components in accordance with ASTM C1007, manufacturer’s instructions, and approved Shop Drawings.

B. Welding: In accordance with AWS D1.3/D1.3M.

C. Make provisions for erection stresses. Provide temporary alignment and bracing.

3.2 INSTALLATION - AXIALLY LOADED STUD FRAMING

A. Place top and bottom tracks in straight lines with ends butted. Fasten tracks at maximum 12 inches
on center.

B. Place studs at spacing indicated and not more than 2 inches from abutting walls and at each side of openings.

C. Connect studs to top and bottom tracks.

D. Construct corners using minimum of three studs.

E. Do not splice studs.

F. Erect, brace, and reinforce stud framing to develop strength to achieve design requirements.

G. Install headers above openings and intermediate studs above and below openings to align with wall stud spacing.

H. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

I. Diagonally brace walls at location indicated.

3.3 INSTALLATION TOLERANCES

A. In accordance with ASTM C1007.

3.4 FIELD QUALITY CONTROL

A. Testing and Inspection Services: Inspect and test shop and field welds in accordance with AWS D1.3/D1.3M.

3.5 ADJUSTING

A. Clean and touch up galvanized coatings at welded and abraded surfaces in accordance with ASTM A780, Annex A1.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Shop fabricated metal components.
   2. Gratings.
   3. Ladders and safety cages.
   4. Guard rails and handrails.
   5. Bollards.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES


B. American Architectural Manufacturers Association (AAMA):
   1. 611 - Voluntary Specification for Anodized Architectural Aluminum.

C. American Welding Society (AWS):
   1. D1.1/D1.1M - Structural Welding Code - Steel.
   3. D1.6/D1.6M - Structural Welding Code - Stainless Steel.

D. ASTM International (ASTM):
   9. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
  10. A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
  12. A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

E. National Association of Architectural Metal Manufacturers (NAAMM):
   1. AMP 503 - Finishes for Stainless Steel.
   2. MBG 531 - Metal Bar Grating Manual.

F. Society for Protective Coatings (SSPC) - Painting Manual.

1.3 SYSTEM DESCRIPTION

A. Minimum Design Loads:
   1. Pedestrian loading:
      a. Uniform load of 100 PSF.
      b. Concentrated load of 300 pounds.
      c. Maximum deflection under loading: L/240.
   2. Guard rails and handrails:
      a. 50 pounds per linear foot applied in any direction at top, transferred via attachments and supports to building structure.
      b. Concentrated 200 pound load applied in any direction at any point along top, transferred via attachments and supports to building structure.
      c. Maximum deflection under loading: L/120.
   3. Concentrated and uniform loads do not need to be applied simultaneously.
   4. Perform design under direct supervision of Professional Structural Engineer licensed in State in which Project is located, with minimum 2 years experience in work of this Section.

B. Fabricate guard rails and handrails in accordance with ASTM E985.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Show dimensions, metal thicknesses, finishes, joints, attachments, and relationship of work to adjacent construction.

B. Quality Control Submittals:
   1. Certificate of Compliance from Professional Structural Engineer performing system design.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store steel above ground on platforms, skids, or other supports; separate with wooden separators.

B. Protect steel from corrosion.

C. Prevent damage to [prime coat] [and] [galvanized coatings].

PART 2 PRODUCTS

2.1 MATERIALS - STEEL

A. Shapes: ASTM A36/A36M.
B. Plate: ASTM A283.

C. Sheet: ASTM A1008/A1008M.


E. Tube: ASTM A500.

F. Bars: ASTM A108.

2.2 MATERIALS - ALUMINUM

A. Extrusions: ASTM B221, 6063-T5 alloy and temper.

B. Sheet: ASTM B209, alloy and temper best suited to application.


2.3 MATERIALS - STAINLESS STEEL

A. Stainless Steel: ASTM A666, Type [304] [or] [316], rollable temper.


2.4 MATERIALS - BAR GRATINGS

A. Steel Rod for Cross Bars: ASTM A510.

B. Aluminum for [Riveting] [Pressure Locking]: ASTM B221, [rectangular] [____] shape.

2.5 ACCESSORIES

A. Exposed Screws: Same material as metal being fastened; Phillips flat head, countersunk, unless noted otherwise.

B. Bolts: ASTM A307, hexagonal head type.

C. Primer Paint: SSPC Paint 15, Type 1, red oxide.

D. Anchoring Cement: Two component epoxy type.

2.6 FABRICATION

A. Fit and shop assemble items in largest practical sections, for delivery to site.

B. Fabricate items with joints tightly fitted and secured.

C. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located, consistent with design of component except where specifically noted otherwise.
E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

F. Conceal fastenings where possible.

G. Welding to conform to AWS D1.6/D1.6M.
   1. Use welds for permanent connections where possible. Grind exposed welds smooth.
   2. Tack welds prohibited on exposed surfaces.

2.7 FINISHES

A. Exterior Ferrous Metal: Galvanized; ASTM A123/A123M, to 2.0 ounces per square foot.

B. Interior Ferrous Metal:
   1. Shop painted except steel to be encased in concrete and surfaces to be welded.
   2. Surface preparation: SSPC SP2 - Hand Tool Cleaning or SP3 - Power Tool Cleaning.
   3. Application: One coat; follow coating manufacturer's instructions.

C. Aluminum: AAMA 2605 fluoropolymer coating containing minimum 70 percent polyvinylidene resins, two coat system, color to be selected from manufacturer's full color range.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install items in accordance with approved Shop Drawings.

B. Install components plumb, level, and rigid.

C. Welding: AWS D1.6/D1.6M. Grind and fill exposed welds; finish smooth and flush.

D. Install sleeved components with anchoring cement.

E. Prevent contact of aluminum and dissimilar metals by use of zinc rich paint, bituminous coating, or non-absorptive gaskets.

3.2 ADJUSTING

A. Clean and touch up damaged primer paint with same product as applied in shop.

B. Clean and touch up galvanized coatings at welded and abraded surfaces in accordance with ASTM A780

3.3 SCHEDULE

A. This Schedule includes principal items only; refer to Drawings for additional items not listed.

B. Guard Rails and Handrails:
   1. Fabricate from steel tube stock of sizes and types indicated.
   2. Make bends uniform and free from buckles and other defects.
   3. Cut intersections square to within 2 degrees and to length within 1/8 inch. Remove burrs from cut ends.
   4. Miter and cope intersections within 2 degrees, fit to within 1/8 inch.
   5. Continuously weld connections.
   6. Where length exceeds that suitable for shipping and handling, fabricate in sections with concealed internal sleeves forming slip joints. Extend sleeves minimum 2 inches on both sides of joint; field weld and grind smooth.
C. Ladders:
1. Side rails: Continuous steel flat bars, [1/2 x 2-1/2 inches, eased edges, spaced 18 inches apart.
2. Rungs: Round steel bars, 3/4 inch diameter, knurled or abrasive coated to ANSI A14.3, spaced 12 inches on center. Fit rungs in centerline of side rails and plug weld on outer rail face.
3. Support ladders at top, bottom, and at intermediate points spaced maximum 5'-0" on center with steel brackets, welded or bolted to supports.

END OF SECTION
SECTION 06 1000 - ROUGH CARPENTRY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Wood blocking and furring.
2. Telephone and electrical panel backboards.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. American Wood Protection Association (AWPA):
1. M4 - Standard for the Care of Preservative Treated Wood Products.

B. ASTM International (ASTM):

C. Engineered Wood Association (APA) PRP-108 - Performance Standards and Qualification Policy for Structural-Use Panels.


E. Southern Pine Inspection Bureau (SPIB) - Standard Grading Rules for Southern Pine Lumber.

1.3 QUALITY ASSURANCE

A. Lumber Grading Agency: Certified to NIST PS 20.
B. Identify lumber and sheet products by official grade mark.
C. Fire Retardant Treated Products: Bear label of recognized independent testing laboratory indicating flame spread rating of 25 or less, tested to ASTM E84.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials minimum 6 inches above ground on framework or blocking and cover with protective waterproof covering providing for adequate air circulation.
B. Do not store seasoned or treated materials in damp location.
C. Protect edges and corners of sheet materials from damage.

PART 2 PRODUCTS

2.1 MATERIALS

A. Lumber:
1. Grading rules: SPIB.
2. Species: Southern Pine (kiln dried post-treatment)
3. Surfacing: Surfaced four sides (S4S) [unless otherwise indicated].
4. Maximum moisture content: 19 percent.

B. Sheet Products:
   1. Type: APA Plywood.
   2. Panel grade: APA
   3. Exposure:
      a. Interior applications: Interior.

2.2 ACCESSORIES

A. Fasteners:
   1. Type and size: As required by conditions of use.
   2. Exterior locations and treated products: Hot-dip galvanized steel, ASTM A153/A153M, G90 coating class. Or Stainless steel, ASTM F593, Type 304 or 316.
   3. Other interior locations: Plain steel.

2.3 FABRICATION

A. Preservative Treatment:
   1. Treat lumber in accordance with AWPA U1:
      a. Interior locations protected from moisture sources: Category UC1 - Interior/Dry.
      b. Interior locations subject to sources of moisture: Category UC2 - Interior/Damp.
      c. Exterior locations above ground: Category UC3A - Above Ground/Protected.
   2. Treatment process: Type [ACQ - Ammoniacal Copper Quaternary (ACQ); free from arsenic, chromium, and other EPA classified hazardous preservatives.

B. Fire Retardant Treatment; treat lumber and in accordance with AWPA U1:
   1. Interior locations: Category UCFA - Fire Retardant/Interior.

PART 3 EXECUTION

3.1 INSTALLATION

A. Provide blocking, nailers, grounds, furring, and other similar items required to receive and support work.

B. Set members level, plumb, and rigid.

C. Curb roof openings except where prefabricated curbs are provided. Form corners by alternating lapping side members.

D. Install telephone and electrical panel backboards where indicated. Oversize panel by 12 inches on all sides.

E. Treat field cuts and holes in members providing structural support in accordance with AWPA M4.

END OF SECTION
SECTION 06 1643
GYPSUM SHEATHING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exterior gypsum wall sheathing.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Illustrate panel product types, thicknesses, and installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. GP Gypsum Corporation. (www.gp.com)
   3. USG Corporation. (www.usg.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Exterior Sheathing: Glass-Fiber Faced Sheathing:
   1. Type: ASTM C1177/C1177M or ASTM C1278/C1278M; 48 inches wide x 5/8 inch thick, maximum practical length, square cut ends and edges.

2.3 ACCESSORIES

A. Fasteners: ASTM C1002, Type S screws, hot-dip galvanized or fluoropolymer coated steel, minimum 5/8 inch penetration into framing.

PART 3 EXECUTION

3.1 INSTALLATION
A. Install in accordance with ASTM C1280 and manufacturer's instructions.

B. Accurately cut panels to fit around openings and projections.

C. Apply panels vertically, with ends and edges occurring over supports.

D. Fasten panels to framing at maximum 8 inches on center. Place fasteners minimum 3/8 inch from edges of panels; drive heads flush with surface. Stagger fasteners at abutting edges.

END OF SECTION
SECTION 07 2113
BOARD INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Board insulation at cavity walls.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   5. E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750 degrees C.

1.3 SUBMITTALS

A. Submittals for Review:
   2. Samples: 12 x 12 inch samples of each insulation.

B. Quality Control Submittals:
   1. Certificates of Compliance: Certification from an independent testing laboratory that insulation meets fire hazard classification requirements.

1.4 QUALITY ASSURANCE

A. Fire Hazard Classification:
   1. Noncombustible, tested to ASTM E136.
   2. Maximum flame spread/smoke developed rating of 75/450, tested to ASTM E84.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store insulation in clean, dry, sheltered area, off ground or floor, until used. Protect against wetting and moisture absorption.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Polyisocyanurate Insulation:
   1. Dyplast Products. (www.dyplastproducts.com)
   3. Rmax, Inc. (www.rmaxinc.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS
A. Board Insulation:
   1. ASTM C1289, rigid polyisocyanurate faced both sides with aluminum foil facings, non-reinforced core.

2.3 ACCESSORIES

A. Adhesive:
   1. Type recommended by insulation manufacturer.

B. Tape: Minimum 2 inches wide, pressure sensitive, foil faced, waterproof.

C. Impale Fasteners:
   1. Steel impaling fasteners on metal base with lock washers, length to suit insulation thickness.
   2. Adhesive: Type recommended by fastener manufacturer.

D. Fasteners: Type best suited to application, hot-dip galvanized or fluoropolymer coated steel.

PART 3 EXECUTION

3.1 PREPARATION

A. Substrate:
   1. Remove protrusions flush with adjacent surface.
   2. Remove dirt, dust, oil, grease, and other materials that could impair adhesion.

3.2 INSTALLATION

A. Apply adhesive in continuous beads.

B. Install boards on perimeter CMU walls, vertically.

C. Place boards in a method to maximize contact bedding.

D. Stagger end joints.

E. Butt edges and ends tight to adjacent boards, at perimeter, and around penetrations.

F. Extend boards over control joints.

G. Cut and fit insulation tight at perimeter and around penetrations.

H. Tape seal to perimeter and at joints between insulation pieces.

END OF SECTION
SECTION 07 2115
BATT INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Batt insulation in interior wall and ceiling assemblies.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):

1.3 SUBMITTALS

A. Quality Control Submittals:
   1. Certificates of Compliance: Certification from an independent testing laboratory that insulation meets fire hazard classification requirements.

1.4 QUALITY ASSURANCE

A. Fire Hazard Classification:
   1. Noncombustible, tested to ASTM E136.
   2. Flame spread/smoke developed rating of 25/50 or less, tested to ASTM E84.

1.5 DELIVERY, STORAGE AND HANDLING

A. Store insulation in clean, dry, sheltered area, off ground or floor, until used. Protect against wetting and moisture absorption.

1.6 PROJECT CONDITIONS

A. Do not install insulation until building is substantially water and weather tight.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Johns Manville. (www.jm.com)
   2. Knauf Insulation. (www.knaufinsulation.us)
   3. Owens Corning. (www.owenscorning.com)

B. Substitutions: [Under provisions of Division 01.] [Not permitted.]

2.2 MATERIALS

A. Acoustical Batt Insulation:
   1. Type: ASTM C665, Type II, Class C glass fiber composition.
   2. Facing: Unfaced.
3. Stapling flanges: [one
4. Free from urea-formaldehyde resins.
5. Thickness:
   a. 3-1/2 inches thick

2.3 ACCESSORIES

A. As required by manufacturer for installation is metal stud framing

PART 3 EXECUTION

3.1 INSTALLATION

A. Friction fit between framing members.
B. Butt insulation to adjacent construction. Butt ends and edges.
C. Carry insulation around pipes, wiring, boxes, and other components.
D. Ensure complete enclosure of spaces without voids.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Foamed-in-place insulation on bottom of metal roof deck.
   2. Foamed-in-place insulation at junctions of dissimilar wall and roof materials to achieve a thermal and air seal.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Provide product description, insulation properties, and preparation requirements.

B. Quality Control Submittals:
   1. Certificates of Compliance: Certification from an independent testing laboratory that insulation meets fire hazard classification requirements.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum 5 years experience in work of this Section.

B. Fire Hazard Classification: Maximum flame spread/smoke developed rating of 25/450, tested to ASTM E84.

1.5 PROJECT CONDITIONS

A. Do not install insulation when ambient temperature is below 70 degrees F.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Core Foam. (www.cfifoam.com)
   2. Demilec USA (www.demilecusa.com)
   3. NCFI Polyurethanes. (www.ncfi.com)
   4. Polymaster, Inc. (www.polymaster.com)
   5. Thermal Corp. of America. (www.thermcofoam.com)
   6. Icynene
B. Substitutions:[Under provisions of Division 01.

2.2 MATERIALS

A. Foamed-In-Place Insulation:
   1. Type: Two component, plastic resin and catalyst, cold setting foam, open cell.
   2. R-value: Minimum 3.8 per inch at 75 degrees F, tested to ASTM C177 or ASTM C518.
   3. No CFC or HCFC emissions and total formaldehyde emissions less than 1 percent, cured for 7 days and tested to ASTM D5116 for 24 hours.

2.3 ACCESSORIES

A. Fire Barrier:
   1. Water-based product for use over spray-applied polyurethane foam insulation on vertical surfaces.
   2. Surface burning characteristics: Class I, tested to ASTM E84.

PART 3 EXECUTION

3.1 PREPARATION

A. Protect adjacent surfaces from accidental application.

3.2 APPLICATION

A. Apply insulation in accordance with manufacturer's instructions.
B. Apply insulation by froth method, to uniform monolithic density without voids.
C. Apply insulation to maximum lift thickness recommended by manufacturer, then allow heat to dissipate before applying additional lifts.
D. Apply fire barrier to insulation in accordance with manufacturer's instructions.
E. Patch access holes with mortar; finish flush with adjacent surfaces.

3.3 ADJUSTING

A. Patch damaged areas.

3.4 FIELD QUALITY CONTROL

A. Testing and Inspection Services:
   1. Visually inspect installed insulation for:
      a. Uniform application.
      b. Adhesion.
      c. Shrinkage.
      d. Gaps, voids, and physical damage.
   2. Perform thickness testing using calibrated probe, with minimum of one test per 500 square feet.
   3. Take core samples at rate of one sample per 3000 square feet, with maximum of 4 samples.

END OF SECTION
SECTION 07 2800
AIR AND MOISTURE BARRIERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fluid applied materials for controlling moisture movement at exterior wall assemblies.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):

1.3 QUALITY ASSURANCE

A. Provide continuous barrier to moisture infiltration, air infiltration and exfiltration, and water vapor transmission, flashed to discharge incidental condensation and water penetration.

B. Mockup:
   1. Construct mockup of typical exterior wall, minimum 8 feet wide x 8 feet high.
   2. Incorporate back-up construction, moisture barrier, typical opening, flashings, and critical junctions.
   3. Locate where directed.
   4. Approved mockup may remain as part of the Work.

C. Pre-Installation Conference:
   1. Convene at site 2 weeks prior to beginning work of this Section.
   2. Attendance: Architect, Contractor, moisture barrier installer, and related trades whose work follows or affects moisture barrier.
   3. Review and discuss:
      a. Surface preparation, minimum substrate curing period, and installation procedures.
      b. Special details and flashings.
      c. Sequence of construction, responsibilities, and schedule for subsequent operations.
      d. Mock-up requirements.
      e. Inspection, protection, and repair procedures.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Manufacturer's descriptive data.
   2. Samples: 12 x 12 inch moisture barrier samples.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Fluid Applied Moisture Barriers:
1. Design Basis: Contract Documents are based on products by Prosoco R-Guard Cat 5 Rain screen.

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Air and Moisture Barrier:
   1. Source: Prosoco R-Guard Cat 5 Rain screen.
   2. Type: Fluid applied, water based, roller grade.
   3. Elongation: Minimum 1000 percent, tested to ASTM D412.
   4. Water vapor transmission: Maximum 0.02 grains per square foot, tested to ASTM E96/E96M.
   5. Air permeance: Maximum 0.0002 CFM per square foot at 3 inch water differential pressure, tested to ASTM E2178.
   6. Assembly air permeance: Maximum 0.0008 CFM per square foot at 0.3 inch water differential pressure, tested to ASTM E2357.
   7. Water leakage: None, tested to ASTM E331 at minimum 6.24 PSF.

2.3 ACCESSORIES

A. Primer: Type recommended by moisture barrier manufacturer.

B. Patching Compound: Type recommended by moisture barrier manufacturer.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean surfaces to receive moisture barrier; remove loose and foreign matter that could impair adhesion or performance.

B. Protect adjacent and underlying surfaces.

C. Fill voids, holes, and cracks over 1/16 inch in width with patching compound; finish flush with adjacent surfaces. Apply one coat of moisture barrier over patched areas and allow to dry.

D. Apply joint tape centered over sheathing joints. Lap ends 2 inches minimum Press to full bond with substrate without voids, wrinkles, bridging, or fishmouths.

3.2 APPLICATION - FLUID APPLIED MOISTURE BARRIERS

A. Apply moisture barrier in accordance with manufacturer's instructions.

B. Apply primer to joints in substrate, inside and outside corners, and around perimeter and penetrations. Apply joint tape over primer; press to full bond with substrate.

C. Apply moisture barrier by roller or spray to continuous and uniform coverage with minimum mil thickness as recommended by manufacturer.

D. Seal to door and window frames, around penetrations, and at perimeter with flashing sheet. Press to full bond with substrate without voids, wrinkles, bridging, or fishmouths.

3.3 FIELD QUALITY CONTROL

A. Inspect moisture barrier for damage just prior to covering.

B. Clean damaged areas and cover with additional moisture barrier material minimum 6 inches larger than damaged area on all sides.
END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Preformed metal roof panel system.
   2. Underlayment.
   3. Flashings, trim, anchorage, and accessories.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 079200 - Joint Sealers.

1.2 REFERENCES

A. American Society of Civil Engineers (ASCE) 7 - Minimum Design Loads for Buildings and Other Structures.

B. American Architectural Manufacturers Association (AAMA):
   1. 621 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.

C. ASTM International (ASTM):
   1. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

D. Energy Star - Qualified Products.


1.3 SYSTEM DESCRIPTION

A. Design Requirements; design roof system to withstand:
   1. Live and dead loads in accordance with Building Code.
   2. Minimum wind pressures in accordance with ASCE 7, with maximum allowable deflection of L/240, tested in accordance with ASTM E1592.
   3. Movement caused by an ambient temperature range of 120 degrees F and a surface temperature range of 160 degrees F.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Show configuration of panels, trim members, and closures.
   2. Product Data: Show system components including panels, trim, and accessories.
   3. Samples:
      a. 3 x 3 inch finish samples showing available colors, on representative backing.
      b. After color selection, submit 12 inch long panel samples in selected color.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 10 years experience in work of this Section.

B. Roof System:
   1. Energy Star certified.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protect panels from contact with materials that could cause staining or discoloration of finish.

1.7 PROJECT CONDITIONS

A. Do not install underlayment at ambient or surface temperatures less than 40 degrees F or on wet or frozen substrate.

B. Do not install panels on wet or frozen substrate.

1.8 WARRANTIES

A. Furnish manufacturer’s 20 year warranty providing coverage against chipping, cracking, fading, or delamination of panel finish.

B. Furnish manufacturer’s 10 year warranty providing coverage against water leakage through roofing system.
   1. Make repairs to roofing system required due to defects in materials or workmanship resulting in water leakage into or through roofing system.
   2. Include cost of labor and materials necessary to make required repairs.
   3. Not limited to specific dollar amount.
   4. Transferable to subsequent building owners during warranty period.
PART 2  PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
1. AEP-Span. (www.aepspan.com)
2. Berridge Manufacturing Co. (www.berridge.com)
4. Fabral. (www.fabral.com)
5. MBCI. (www.mbci.com)
6. Petersen Aluminum Corp. (www.pac-clad.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Aluminum Sheet:
1. ASTM B209, alloy 3015-H14 or equivalent.

B. Underlayment:
1. Description: ASTM D1970; minimum 40 mil thick polymer modified asphalt laminated to slip-resistant polyethylene film, self adhering with release paper facing, specifically formulated for extended high in-service temperatures up to 260 degrees F.
2. Elongation: Minimum 250 percent, tested to ASTM D412.
3. Tensile strength: Minimum 250 PSI, tested to ASTM D412.

2.3 ACCESSORIES

A. Fasteners:
1. Underlayment: Self-adhering
2. Panels and trim: 300 Series stainless steel, type best suited to application; head color to match panels where exposed, with neoprene gasketed washers.

B. Panel Clips: Hot-dip galvanized steel, thermally responsive, designed to fit between two adjacent panels and secure both panels.

C. Panel End Closures: “Z” closures, sealed all edges.

D. Joint Sealers: Specified in Section 079200.

2.4 FABRICATION

A. Fabricate panels from .032 minimum inch thick aluminum sheet.

B. Panel Profile: standing] seams spaced 16” inches on center with intermediate stiffening ribs at 4” inches on center, interlocking edges with factory-applied seam tape or sealant.

C. Trim: Profiles as indicated or as required, fabricated from same material as panels.

D. Roll form panels and trim to required profiles in longest practical lengths.

2.5 FINISHES

A. Panels and Trim: AAMA 2605, fluoropolymer coating containing minimum 70 percent PVDF resins, color to be selected from manufacturer’s full color range.

PART 3  EXECUTION

3.1 INSTALLATION OF UNDERLAYMENT
A. Starting at low edge, apply underlayment horizontally on roof. Weatherlap each sheet 4 inches over preceding sheet. Lap ends 6 inches minimum.

B. Press to full bond with substrate without voids, wrinkles, bridging, or fishmouths. Seal ends and edges.

C. Lap underlayment minimum 12 inches over hips and ridges from both sides. Apply 36 inch wide strip centered lengthwise over ridge.

D. Extend minimum 4 inches up abutting vertical surfaces.

3.2 INSTALLATION OF METAL PANELS

A. Install in accordance with manufacturer's instructions and approved Shop Drawings.

B. Install aligned, level, and plumb.

C. Fasten panels using concealed panel clips. Exposed fasteners permitted on trim members only.

D. Install panels in continuous lengths from eave to ridge without end joints.

E. Install trim to maintain visual continuity of system.

F. Install joint sealers and gaskets to prevent water penetration.

G. Flash penetrations through roofing with metal trim to match panels:
   1. Lap flashings over roof panels inches minimum on all sides and seal with double bead of joint sealer.
   2. Install metal draw band and joint sealer at top of pipe penetrations.
   3. Install water diverter at uphill side of square and rectangular penetrations.

H. Installation Tolerances:
   1. Variation from location: Plus or minus 1/4 inch.
   2. Variation from plane: 1/4 inch in 10 feet.

3.3 ADJUSTING

A. Touch up field cuts and abrasions on finished surfaces to match factory finish.

END OF SECTION
SECTION 07 6200

SHEET METAL FLASHING AND TRIM

PART 1  GENERAL

1.1  SUMMARY

A.  Section Includes:
1. Metal flashings and trim.
2. Copings.
3. Gutters, scuppers, conductor heads and downspouts.
5. Counterflashings at roof mounted equipment and utility penetrations.

B.  Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.
2. Section 07 9200 - Joint Sealers.

1.2  REFERENCES

A.  American Architectural Manufacturers Association (AAMA):
1. 611 - Voluntary Specification for Anodized Architectural Aluminum.
2. 621 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.


C.  ASTM International (ASTM):
1. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
2. A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.

D.  Sheet Metal and Air Conditioning Manufacturer’s Association International (SMACNA) - Architectural Sheet Metal Manual.

1.3  SUBMITTALS

A.  Submittals for Review:
1. Shop Drawings: Show locations, types and thicknesses of metal, profiles, dimensions, fastening methods, provisions for expansion and contraction, and joint details.
2. Samples:
a. Each flashing and trim profile, minimum 12 inches long. Include corners where applicable.
b. 3 x 3 inch prefinished metal samples showing available colors.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Minimum 10 years documented experience in work of this Section.
B. Design, fabricate, and install metal copings in accordance with ANSI/SPRI ES-1.
C. Conform to SMACNA Manual for nominal sizing of gutters, scuppers, collector boxes and downspouts for rainfall intensity determined by a storm occurrence of 1 in 100 years.

PART 2 PRODUCTS

2.1 MATERIALS

A. Aluminum Sheet:
   1. ASTM B209, alloy 3003, temper H14, 0.032 inch thick.
   2. Finish: AAMA 621, fluoropolymer coating, containing minimum 70 percent PVDF resins, color to be selected from manufacturer's full color range.

2.2 ACCESSORIES

A. Solder: ASTM B32.
B. Fasteners: Stainless steel, with neoprene gasketed washers where exposed.
C. Joint Sealers: Specified in Section 07 9200.

2.3 FABRICATION

A. Fabricate components in accordance with SMACNA Manual.
B. Profiles:
   1. Gutters: SMACNA
   2. Downspouts: SMACNA
   3. Fabricate end caps, downspout outlets and headers, straps, brackets, and downspout strainers in profile to suit gutters and downspouts.
C. Fabricate corners in single units with minimum 18 inch long legs.
D. Fabricate vertical faces with bottom edge formed outward 1/4 inch and hemmed to form drip.
E. Form sections accurate to size and shape, square and free from distortion and defects.
F. Provide for thermal expansion and contraction in sheet metal:
   1. Gutters:
      a. Place expansion joints at maximum 50 feet on center.
b. Locate expansion joints between downspouts; prevent water flow over joint.

2. Other sheet metal:
   a. Place expansion joints at 10 feet on center maximum and maximum 2 feet from corners and intersections.

3. Joint width: Consistent with types and sizes of materials, minimum width 1/4 inch.

G. Fabricate expansion joints in metal copings with backing and cover plates formed to flashing profile, minimum 8 inches long.

H. Unless otherwise indicated, provide minimum 3/4 inch wide flat lock seams; lap in direction of water flow.

I. Fabricate cleats and starter strips of same material as sheet metal.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install flashing and sheet metal as indicated and in accordance with SMACNA Manual.

B. Install cleats and starter strips before starting installation of sheet metal. Fasten at 6 inches on center maximum.

C. Expansion Joints in Metal Copings:
   1. Center backing plate between flashing pieces at end joints.
   2. Apply two continuous beads of joint sealer between backing plate and flashing sections at each end.
   3. Install flashing pieces with 1/2 inch expansion space at abutting ends; apply sealer to expansion space.
   4. Apply two continuous beads of joint sealer between cover plate and flashing sections at each end.

D. Secure flashings with concealed fasteners where possible.

E. Apply plastic cement between metal and bituminous flashings.

F. Fit flashings tight, with square corners and surfaces true and straight.

G. Seam and seal field joints.

H. Separate dissimilar metals with bituminous coating or non-absorptive gaskets.

I. Reglets:
   1. Install reglets true to line and level. Seal top of surface mounted reglet with joint sealer.
   2. Install flashings into reglets to form tight fit. Secure with lead or plastic wedges at 9 inches on center maximum. Seal remaining space with joint sealer.

J. Gutters: Secure with straps spaced maximum 36 inches on center and within 12 inches of ends.

K. Downspouts:
   1. Secure with straps spaced maximum 8 feet on center and within 2 feet of ends and elbows.
   2. Flash downspouts into gutters and conductor heads and fasten.
   3. Flash upper sections into lower sections minimum 2 inches at joints; fasten sections together.

L. Apply joint sealers as specified in Section 07 9200.
3.2 CLEANING

A. Clean sheet metal; remove slag, flux, stains, spots, and minor abrasions without etching surfaces.

END OF SECTION
SECTION 07 6500
FLEXIBLE FLASHINGS

PART 1  GENERAL

1.1  SUMMARY

A. Section Includes:
   1. Rubberized asphalt sheet for concealed wall flashings

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2  REFERENCES


1.3  SUBMITTALS

A. Submittals for Review:
   1. Product Data: Manufacturer’s descriptive data and installation instructions.

1.4  PROJECT CONDITIONS

A. Do not apply flashings at ambient or surface temperatures less than 40 degrees F.

PART 2  PRODUCTS

2.1  MANUFACTURERS

A. Acceptable Manufacturers:
   3. Polyguard Products, Inc. (www.polyguardproducts.com)

B. Substitutions: Under provisions of Division 01.

2.2  MATERIALS

A. Rubberized Asphalt Flashings:
   1. Description: ASTM D1970; minimum 32 mil thick butyl rubber modified asphalt laminated to 8 mil thick cross-laminated HDPE film, release paper facing, self adhering.

2.3  ACCESSORIES

A. Termination Mastic: Type recommended by flashing manufacturer.

PART 3  EXECUTION

3.1  INSTALLATION

A. Provide flexible flashings in exterior wall assemblies at:
   1. Base of walls.
   3. Top of walls under copings.
   4. Transitions between materials.
   5. Around openings and penetrations through walls.

B. Lap ends 4 inches minimum.
C. Press to full bond with substrate without voids, wrinkles, bridging, or fishmouths.

D. Roll ends and edges with hand held roller; ensure tight seal.

E. Apply trowel coat of mastic along flashing at top edge, seams, cuts, and penetrations.

END OF SECTION
SECTION 07 8400

FIRESTOPPING

PART 1  GENERAL

1.1  SUMMARY

A. Section Includes:
   1. Firestopping perimeter of and penetrations through fire rated assemblies.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2  REFERENCES

A. ASTM International (ASTM):

B. Underwriters Laboratories, Inc. (UL):
   1. 1479 - Fire Tests of Through-Penetration Firestops.

1.3  SYSTEM DESCRIPTION

A. Provide continuous protection against passage of heat, fire, smoke, and gases at perimeter of and penetrations through rated assemblies.

1.4  SUBMITTALS

A. Submittals for Review:
   1. Product Data:
      a. Firestopping schedule; prepare in tabular format and identify:
         1) Type of assembly receiving firestop and required fire rating.
         2) Type of penetrating item.
         3) Proposed firestop system.
      b. Include UL or equivalent details for each firestop system.

B. Quality Control Submittals:
   1. Certificates of Compliance: Indicate conformance of installed systems with specified requirements.

1.5  QUALITY ASSURANCE

A. Firestopping: Fire resistance rating equivalent to adjacent construction; tested to ASTM E814, ASTM E1966, ASTM E2307, UL 1479, or UL 2079.

1.6  PROJECT CONDITIONS

A. Do not apply sealants, mortars, or putties when temperature of substrate material and surrounding air is below 40 degrees F or is anticipated to drop below that temperature within 24 hours after installation.

PART 2  PRODUCTS

07 8400-1  Firestopping
2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Hilti, Inc. (www.us.hilti.com)
   2. 3M Fire Protective Products. (www.3m.com)
   3. Rectorseal. (www.rectorseal.com)
   5. Tremco, Inc. (www.tremcoscaleants.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Firestopping: One or more of the following:
   1. Silicone elastomer compound: Single or multiple component, low modulus, moisture curing silicone sealant.
   2. Ceramic sealant: Single component, moisture curing ceramic sealant.
   3. Intumescent sealant: Single component, water based intumescent sealant.
   5. Putty: Single component ceramic fiber base putty or intumescent elastomer putty that expands on exposure to surface heat gain.
   7. Pillows or blocks: Formed intumescent or mineral fiber pillows or blocks.
   8. Intumescent strips: Solvent free intumescent wrap strips.
   9. Mechanical devices: Incombustible fillers or silicone elastomer covered with sheet stainless steel jacket, joined with collars, penetration sealed with flanged stops.

2.3 ACCESSORIES

A. Forming and Damming Materials: As recommended by firestopping manufacturer for intended use.
   1. Permanent: Mineral fiber board, mineral fiber matting, or mineral fiber putty.
   2. Temporary: Plywood, particle board, or other.

PART 3 EXECUTION

3.1 PREPARATION

A. Prepare openings to receive firestopping as directed by manufacturer:
   1. Remove incidental and loose materials from penetration opening.
   2. Remove free liquids and oil from involved surfaces and penetration components.
   3. Install damming materials to accommodate and ensure proper thickness and fire rating requirements and provide containment during installation.
   4. Remove combustible materials and materials not intended for final penetration seal system.

3.2 INSTALLATION

A. Install firestopping at perimeter of and penetrations through [fire] [and] [smoke] rated assemblies.

B. Apply materials in accordance with manufacturer's instructions.

C. Apply firestopping material in sufficient thickness to achieve required ratings.

D. Compress fibered material to achieve a density of 40 percent of its uncompressed density.

E. Place foamed material in layers to ensure homogenous density, filling cavities and spaces. Place sealant to completely seal junctions with adjacent dissimilar materials.

F. Place intumescent coating in sufficient coats to achieve rating required.
G. Remove dam material after firestopping material has cured.
H. Finish exposed surfaces to smooth, flush appearance.

END OF SECTION
SECTION 07 9200
JOINT SEALERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Joint backup materials.
   2. Joint sealers.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Indicate sealers, primers, backup materials, bond breakers, and accessories proposed for use.
   2. Samples:
      a. 1/2 x 1/2 x 3 inch long joint sealer samples [showing available colors].
      b. 6 inch long joint backup material samples.
   3. Warranty: Sample warranty form.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum 10 years experience in work of this Section.

A. Field Pre-Construction Testing:
   1. Perform field testing for sealant adhesion in accordance with ASTM C1521 on exterior mockup, prior to beginning application, and for each 1000 feet of installed sealer.
   2. Install sealers using joint preparation methods and materials recommended by sealer manufacturer.
   3. When tests indicate sealant adhesion failure, modify joint preparation, primer, or both and retest until joint passes sealant adhesion test.

1.2 PROJECT CONDITIONS
A. Do not apply sealers at temperatures below 40 degrees F unless approved by sealer manufacturer.

1.3 Warranties

A. Furnish applicator's 10 year warranty providing coverage for sealers and accessories that fail to provide air and water tight seal, exhibit loss of adhesion or cohesion, or do not cure.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. BASF Building Systems. (www.buildingsystems.basf.com)
   2. Dow Corning Corp. (www.dowcorning.com)
   3. GE Silicones. (www.siliconeforbuilding.com)
   4. Pecora Corp. (www.pecora.com)
   5. Sika Corp. (www.sikausa.com)
   6. Tremco, Inc. (www.tremco.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Joint Sealer Type 1:
   1. ASTM C834, single component acrylic latex, non sag.
   2. Movement capability: Plus or minus 7-1/2 percent.

B. Joint Sealer Type 2:
   1. ASTM C920, Grade NS, single component silicone, non sag, mildew resistant.
   2. Movement capability: Plus or minus 50 percent.
   3. Color: To be selected from manufacturer's full color range.

C. Joint Sealer Type 3:
   1. ASTM C834, single component acrylic latex, non sag, non-hardening, non-corrosive, recommended by manufacturer for acoustical applications.
   2. Movement capability: Plus or minus 7-1/2 percent.

2.3 ACCESSORIES

A. Primers, Bondbreakers, and Solvents: As recommended by sealer manufacturer.

B. Joint Backing:
   1. ASTM C1330, closed cell polyethylene foam, preformed round joint filler, non absorbing, non staining, resilient, compatible with sealer and primer, recommended by sealer manufacturer for each sealer type.
   2. Size: Minimum 1.25 times joint width.

2.4 MIXES

A. Mix multiple component sealers in accordance with manufacturer's instructions.
   1. Mix with mechanical mixer; prevent air entrainment and overheating.
   2. Continue mixing until color is uniform.

PART 3 EXECUTION

3.1 PREPARATION
A. Remove loose and foreign matter that could impair adhesion. If surface has been subject to chemical contamination, contact sealer manufacturer for recommendation.

B. Clean and prime joints in accordance with manufacturer’s instructions.

C. Protect adjacent surfaces with masking tape or protective coverings.

D. Sealer Dimensions:
   1. Minimum joint size: 1/4 x 1/4 inch.
   2. Joints 1/4 to 1/2 inch wide: Depth equal to width.
   3. Joints over 1/2 inch wide: Depth equal to one half of width.

3.2 APPLICATION

A. Apply products in accordance with manufacturer’s instructions.

B. Install sealers and accessories in accordance with ASTM C1193.

C. Install acoustical sealers and accessories in accordance with ASTM C919.

D. Install joint backing to maintain required sealer dimensions. Compress backing approximately 25 percent without puncturing skin. Do not twist or stretch.

E. Use bondbreaker tape where joint backing is not installed.

F. Fill joints full without air pockets, embedded materials, ridges, and sags.

G. Tool sealer to smooth profile.

H. Apply sealer within manufacturer’s recommended temperature range.

3.3 CLEANING

A. Remove masking tape and protective coverings after sealer has cured.

B. Clean adjacent surfaces.

END OF SECTION
SECTION 08 7100
DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY:

A. Section Includes: Finish Hardware for door openings, except as otherwise specified herein.

1. Door hardware for steel (hollow metal) doors.
2. Door hardware for aluminum doors.
3. Door hardware for wood doors.
4. Door hardware for other doors indicated.
5. Keyed cylinders as indicated.

B. Related Sections:
1. Division 6: Rough Carpentry.
2. Division 8: Aluminum Doors and Frames.
3. Division 8: Hollow Metal Doors and Frames.
5. Division 26 Electrical
6. Division 28: Electronic Security

C. References: Comply with applicable requirements of the following standards. Where these standards conflict with other specific requirements, the most restrictive shall govern.

1. Builders Hardware Manufacturing Association (BHMA)
3. NFPA 80 - Standard for Fire Doors and Other Opening Protectives
4. ANSI-A156.xx - Various Performance Standards for Finish Hardware
5. UL10C – Positive Pressure Fire Test of Door Assemblies
7. DHI /ANSI A115.IG – Installation Guide for Doors and Hardware
9. Miami-Dade requirements for Hurricane (NOA) for exterior openings.

D. Intent of Hardware Groups

1. Should items of hardware not definitely specified be required for completion of the Work, furnish such items of type and quality comparable to adjacent hardware and appropriate for service required.
2. Where items of hardware aren't definitely or correctly specified, are required for completion of the Work, a written statement of such omission, error, or other discrepancy to be submitted to Architect, prior to date specified for receipt of bids for clarification by addendum; or, furnish such items in the type and quality established by this specification, and appropriate to the service intended.

E. Allowances

1. Refer to Division 1 for allowance amount and procedures.

F. Alternates
1. Refer to Division 1 for Alternates and procedures.

1.2 SUBSTITUTIONS:

A. Comply with Division 1.

1.3 SUBMITTALS:

A. Comply with Division 1.

B. Special Submittal Requirements: Combine submittals of this Section with Sections listed below to ensure the "design intent" of the system/assembly is understood and can be reviewed together.

C. Product Data: Manufacturer's specifications and technical data including the following:

1. Detailed specification of construction and fabrication.
2. Manufacturer's installation instructions.
3. Wiring diagrams for each electric product specified. Coordinate voltage with electrical before submitting.
4. Submit 6 copies of catalog cuts with hardware schedule.
5. Provide 9001-Quality Management and 14001-Environmental Management for products listed in Materials Section 2.2

D. Shop Drawings - Hardware Schedule: Submit 6 complete reproducible copy of detailed hardware schedule in a vertical format.

1. List groups and suffixes in proper sequence.
2. Completely describe door and list architectural door number.
3. Manufacturer, product name, and catalog number.
4. Function, type, and style.
5. Size and finish of each item.
7. Explanation of abbreviations and symbols used within schedule.
8. Detailed wiring diagrams, specially developed for each opening, indicating all electric hardware, security equipment and access control equipment, and door and frame rough-ins required for specific opening.

E. Templates: Submit templates and "reviewed Hardware Schedule" to door and frame supplier and others as applicable to enable proper and accurate sizing and locations of cutouts and reinforcing.

1. Templates, wiring diagrams and "reviewed Hardware Schedule" of electrical terms to electrical for coordination and verification of voltages and locations.

F. Samples: (If requested by the Architect)

1. 1 sample of Lever and Rose/Escutcheon design, (pair).
2. 3 samples of metal finishes

G. Contract Closeout Submittals: Comply with Division 1 including specific requirements indicated.

1. Operating and maintenance manuals: Submit 3 sets containing the following.
a. Complete information in care, maintenance, and adjustment, and data on repair and replacement parts, and information on preservation of finishes.
b. Catalog pages for each product.
c. Name, address, and phone number of local representative for each manufacturer.
d. Parts list for each product.

2. Copy of final hardware schedule, edited to reflect, "As installed".
3. Copy of final keying schedule.
4. As installed "Wiring Diagrams" for each piece of hardware connected to power, both low voltage and 120 volts AC.
5. One set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

1.4 QUALITY ASSURANCE

A. Comply with Division 1.

1. Exterior Openings Severe Windstorm Components testing: Listed and labeled by a testing and inspecting agency acceptable to authority having jurisdiction, based on testing according to ANSI A250.13. Further compliance with Florida Building Codes for Hurricane (NOA) for Exterior Openings.
2. Statement of qualification for distributor and installers.
3. Statement of compliance with regulatory requirements and single source responsibility.
4. Distributor's Qualifications: Firm with 3 years experience in the distribution of commercial hardware.
   a. Distributor to employ full time Architectural Hardware Consultants (AHC) for the purpose of scheduling and coordinating hardware and establishing keying schedule.
   b. Hardware Schedule shall be prepared and signed by an AHC.
5. Installer's Qualifications: Firm with 3 years experience in installation of similar hardware to that required for this Project, including specific requirements indicated.
6. Regulatory Label Requirements: Provide testing agency label or stamp on hardware for labeled openings.
   a. Provide UL listed hardware for labeled and 20-minute openings in conformance with requirements for class of opening scheduled.
   b. Underwriters Laboratories requirements have precedence over this specification where conflict exists.
7. Single Source Responsibility: Except where specified in hardware schedule, furnish products of only one manufacturer for each type of hardware.

B. Review Project for extent of finish hardware required to complete the Work. Where there is a conflict between these Specifications and the existing hardware, notify the Architect in writing and furnish hardware in compliance with the Specification unless otherwise directed in writing by the Architect.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Comply with Division 1.

1. Deliver products in original unopened packaging with legible manufacturer's identification.
2. Package hardware to prevent damage during transit and storage.
3. Mark hardware to correspond with "reviewed hardware schedule".
4. Deliver hardware to door and frame manufacturer upon request.

B. Storage and Protection: Comply with manufacturer's recommendations.

1.6 PROJECT CONDITIONS:

A. Coordinate hardware with other work. Furnish hardware items of proper design for use on doors and frames of the thickness, profile, swing, security and similar requirements indicated, as necessary for the proper installation and function, regardless of omissions or conflicts in the information on the Contract Documents.

B. Review Shop Drawings for doors and entrances to confirm that adequate provisions will be made for the proper installation of hardware.

1.7 WARRANTY:

A. Refer to Conditions of the Contract

B. Manufacturer's Warranty:

1. Closers: Ten years
2. Exit Devices: Three Years
3. Locksets & Cylinders: Three years
4. All other Hardware: Two years.

1.8 OWNER’S INSTRUCTION:

A. Instruct Owner’s personnel in operation and maintenance of hardware units.

1.9 MAINTENANCE:

A. Extra Service Materials: Deliver to Owner extra materials from same production run as products installed. Package products with protective covering and identify with descriptive labels. Comply with Division 1 Closeout Submittals Section.

1. Special Tools: Provide special wrenches and tools applicable to each different or special hardware component.
2. Maintenance Tools: Provide maintenance tools and accessories supplied by hardware component manufacturer.
3. Delivery, Storage and Protection: Comply with Owner’s requirements for delivery, storage and protection of extra service materials.

B. Maintenance Service: Submit for Owner’s consideration maintenance service agreement for electronic products installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS:

A. The following manufacturers are approved subject to compliance with requirements of the Contract Documents. Approval of manufacturers other than those listed shall be in accordance with Division 1.

<table>
<thead>
<tr>
<th>Item</th>
<th>Manufacturer</th>
<th>Approved</th>
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</table>

Door Hardware
Section 08 7100
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<th>Hardware Type</th>
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<th>Manufacturer 2</th>
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<tr>
<td>Hinges</td>
<td>Stanley Bommer, McKinney</td>
<td>Best 45H Schlage L9000, Dorma M9000</td>
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<td>Locksets</td>
<td>Best SFIC</td>
<td>Best Existing no Substitution</td>
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<td>Cylinders</td>
<td>Precision</td>
<td>Von Duprin 98/99, Dorma 9000</td>
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<tr>
<td>Exit Devices</td>
<td>Precision</td>
<td>Von Duprin 98/99, Dorma 9000</td>
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<tr>
<td>Closers</td>
<td>Stanley Comm</td>
<td>Dorma 8900, Sargent 281</td>
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<tr>
<td>Threshold &amp; Gasketing</td>
<td>Trimco National Guard</td>
<td>Reese, K.N. Crowder</td>
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</tbody>
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2.2 MATERIALS:

A. Hinges:

1. Template screw hole locations
2. Minimum of 2 permanently lubricated non-detachable bearings
3. Equip with easily seated, non-rising pins
4. Sufficient size to allow 180-degree swing of door
5. Furnish hinges with five knuckles and concealed bearings
6. Provide hinge type as listed in schedule.
7. Furnish 3 hinges per leaf to 7-foot 6-inch height. Add one for each additional 30 inches in height or fraction thereof.
8. Tested and approved by BHMA for all applicable ANSI Standards for type, size, function and finish
9. UL10C listed for Fire rated doors.

B. Mortise Type Locks and Latches:

1. Tested and approved by BHMA for ANSI A156.13, Series 1000, Operational Grade 1, Extra-Heavy Duty, Security Grade 2 and be UL10C.
2. Furnish UL or recognized independent laboratory certified mechanical operational testing to 4 million cycles minimum.
4. Fit ANSI A115.1 door preparation
5. Functions and design as indicated in the hardware groups
6. Solid, one-piece, 3/4-inch (19mm) throw, anti-friction latchbolt made of self-lubricating stainless steel
7. Deadbolt functions shall have 1-inch (25mm) throw bolt made of hardened stainless steel
8. Latchbolt and Deadbolt are to extend into the case a minimum of 3/8 inch (9.5mm) when fully extended
9. Auxiliary deadlatch to be made of one-piece stainless steel, permanently lubricated
10. Provide sufficient curved strike lip to protect door trim
11. Lever handles must be of forged or cast brass, bronze or stainless-steel construction and conform to ANSI A117.1. Levers that contain a hollow cavity are not acceptable
12. Lock shall have self-aligning, thru-bolted trim
13. Levers to operate a roller bearing spindle hub mechanism
14. Mortise cylinders of lock shall have a concealed internal setscrew for securing the cylinder to the lockset. The internal setscrew will be accessible only by removing the core, with the control key, from the cylinder body.
15. Spindle to be designed to prevent forced entry from attacking of lever
16. Provide locksets with 7-pin removable and interchangeable core cylinders
17. Each lever to have independent spring mechanism controlling it
18. Core face must be the same finish as the lockset.
C. Exit Devices shall:

1. Tested and approved by BHMA for ANSI 156.3, Grade 1
3. Furnish UL or recognized independent laboratory certified mechanical operational testing to 10 million cycles minimum.
4. Provide a deadlocking latchbolt
5. Non-fire rated exit devices shall have cylinder dogging.
6. Touchpad shall be “T” style
7. Exposed components shall be of architectural metals and finishes.
8. Lever design shall match lockset lever design
9. Provide strikes as required by application.
10. Fire exit devices to be listed for UL10C
11. UL listed for Accident Hazard
12. Shall consist of a cross bar or push pad, the actuating portion of which extends across, shall not be less than one half the width of the door leaf.
13. Provide vandal resistant or breakaway trim
14. Aluminum vertical rod assemblies are acceptable only when provide with the manufacturers optional top and bottom stainless steel rod guard protectors.

D. Cylinders:

1. Provide the necessary cylinder housings, collars, rings & springs as recommended by the manufacturer for proper installation.
2. Provide the proper cylinder cams or tail piece as required to operate all locksets and other keyed hardware items listed in the hardware sets.
3. Coordinate and provide as required for related sections.

E. Door Closers shall:

1. Tested and approved by BHMA for ANSI 156.4, Grade 1
2. UL10C certified
4. Closer shall have extra-duty arms and knuckles
5. Conform to ANSI 117.1
6. Maximum 2 7/16” case projection with non-ferrous cover
7. Separate adjusting valves for closing and latching speed, and backcheck
8. Provide adapter plates, shim spacers and blade stop spacers as required by frame and door conditions
9. Full rack and pinion type closer with 1 1/2” minimum bore
10. Mount closers on non-public side of door, unless otherwise noted in specification
11. Closers shall be non-handed, non-sized and multi-sized.

F. Door Stops: Provide a dome floor or wall stop for every opening as listed in the hardware sets.

1. Wall stop and floor stop shall be wrought bronze, brass or stainless steel.
2. Provide fastener suitable for wall construction.
3. Coordinate reinforcement of walls where wall stop is specified.
4. Provide dome stops where wall stops are not practical. Provide spacers or carpet riser for floor conditions encountered

G. Over Head Stops: Provide a Surface mounted or concealed overhead when a floor or wall stop cannot be used or when listed in the hardware set.

1. Concealed overhead stops shall be heavy duty bronze or stainless steel.
2. Surface overhead stops shall be heavy duty bronze or stainless steel.
H. Kickplates: Provide with four beveled edges ANSI J102, 10 inches high by width less 2 inches on single doors and 1 inch on pairs of doors. Furnish oval-head countersunk screws to match finish.

I. Door Bolts: Flush bolts for wood or metal doors.
   1. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 25 for hollow metal label doors.
   2. Provide a set of Automatic bolts, Certified ANSI/BHMA 156.3 Type 27 at wood label doors.
   3. Manual flush bolts, Certified ANSI/BHMA 156.16 at openings where allowed local authority.
   4. Provide Dust Proof Strike, Certified ANSI/BHMA 156.16 at doors with flush bolts without thresholds.

J. Coordinator and Brackets: Provide a surface mounted coordinator when automatic bolts are used in the hardware set.
   1. Coordinator, Certified ANSI/BHMA A1156.3 Type 21A for full width of the opening.
   2. Provide mounting brackets for soffit applied hardware.
   3. Provide hardware preparation (cutouts) for latches as necessary.

K. Seals: All seals shall be finished to match adjacent frame color. Seals shall be furnished as listed in schedule. Material shall be UL listed for labeled openings.

L. Weatherstripping: Provide at head and jambs only those units where resilient or flexible seal strip is easily replaceable. Where bar-type weatherstrip is used with parallel arm mounted closers install weatherstrip first.
   1. Weatherstrip shall be resilient seal of (Neoprene, Polyurethane, Vinyl, Pile, Nylon Brush, Silicone)
   2. UL10C Positive Pressure rated seal set when required.

M. Door Bottoms/Sweeps: Surface mounted or concealed door bottom where listed in the hardware sets.
   1. Door seal shall be resilient seal of (Neoprene, Polyurethane, Nylon Brush, Silicone)
   2. UL10C Positive Pressure rated seal set when required.

N. Thresholds: Thresholds shall be aluminum beveled type with maximum height of ½” for conformance with ADA requirements. Furnish as specified and per details. Provide fasteners and screws suitable for floor conditions.

O. Silencers: Furnish silencers on all interior frames; 3 for single doors, 2 for pairs. Omit where any type of seals occur.

2.3 FINISH:

A. Designations used in Schedule of Finish Hardware - 3.05, and elsewhere to indicate hardware finishes are those listed in ANSI/BHMA A156.18 including coordination with traditional U.S. finishes shown by certain manufacturers for their products

B. Powder coat door closers to match other hardware, unless otherwise noted.
C. Aluminum items shall be finished to match predominant adjacent material. Seals to coordinate with frame color.

2.4 KEYS AND KEYING:

A. Provide keyed brass construction cores and keys during the construction period. Construction control and operating keys and core shall not be part of the Owner’s permanent keying system or furnished in the same keyway (or key section) as the Owner's permanent keying system. Permanent cores and keys (prepared according to the accepted keying schedule) will be furnished to the Owner.

B. Cylinders, removable and interchangeable core system: Match Owner’s existing Best 7-pin. Cores and keyway.

C. Permanent keys and cores: Stamped with the applicable key mark for identification. These visual key control marks or codes will not include the actual key cuts. Permanent keys will also be stamped “Do Not Duplicate.”

D. Transmit Grand Masterkeys, Masterkeys and other Security keys to Owner by Registered Mail, return receipt requested.

E. Furnish keys in the following quantities:

1. 1 each Grand Masterkeys
2. 4 each Masterkeys
3. 2 each Change keys each keyed core
4. 15 each Construction masterkeys
5. 1 each Control keys

F. The Owner, or the Owner’s agent, will install permanent cores and return the construction cores to the Hardware Supplier. Construction cores and keys remain the property of the Hardware Supplier.

G. Keying Schedule: Arrange for a keying meeting, and programming meeting with Architect, Owner, hardware supplier, and other involved parties to ensure locksets and locking hardware, are functionally correct and keying and programming complies with project requirements. Furnish three (3) typed copies of keying and programming schedule to Architect.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of conditions: Examine doors, frames, related items and conditions under which Work is to be performed and identify conditions detrimental to proper and or timely completion.

1. Do not proceed until unsatisfactory conditions have been corrected.

3.2 HARDWARE LOCATIONS:

A. Mount hardware units at heights indicated in the following publications except as specifically indicated or required to comply with the governing regulations.

1. Recommended Locations for Builder’s Hardware for Standard Steel Doors and Frames, by the Door and Hardware Institute (DHI).
2. Recommended locations for Architectural Hardware for flush wood doors (DHI).


3.3 INSTALLATION:

A. Install each hardware item per manufacturer's instructions and recommendations. Do not install surface mounted items until finishes have been completed on the substrate. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.

B. Conform to local governing agency security ordinance.

C. Install Conforming to ICC/ANSI A117.1 Accessible and Usable Building and Facilities.

1. Adjust door closer sweep periods so that from the open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the landing side of the door.

D. Installed hardware using the manufacturers fasteners provided. Drill and tap all screw holes located in metallic materials. Do not use "Riv-Nuts" or similar products.

3.4 FIELD QUALITY CONTROL AND FINAL ADJUSTMENT

A. Contractor/Installers, Field Services: After installation is complete, contractor shall inspect the completed door openings on site to verify installation of hardware is complete and properly adjusted, in accordance with both the Contract Documents and final shop drawings.

1. Check and adjust closers to ensure proper operation.

2. Check latchset, lockset, and exit devices are properly installed and adjusted to ensure proper operation.

   a. Verify levers are free from binding.
   b. Ensure latchbolts and dead bolts are engaged into strike and hardware is functioning.

3. Report findings, in writing, to architect indicating that all hardware is installed and functioning properly. Include recommendations outlining corrective actions for improperly functioning hardware if required.

3.5 SCHEDULE OF FINISH HARDWARE:

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>BE</td>
<td>Best Access Solutions</td>
</tr>
<tr>
<td>BY</td>
<td>By Others</td>
</tr>
<tr>
<td>NA</td>
<td>National Guard</td>
</tr>
<tr>
<td>PR</td>
<td>Precision Hardware, Inc.</td>
</tr>
<tr>
<td>RS</td>
<td>Reese Enterprises, Inc.</td>
</tr>
<tr>
<td>SH</td>
<td>Stanley Commercial Hardware</td>
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Manufacturer List
ST  Stanley
TR  Trimco

### Finish List

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<thead>
<tr>
<th>Code</th>
<th>Description</th>
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<tbody>
<tr>
<td>600</td>
<td>Primed for Painting</td>
</tr>
<tr>
<td>626</td>
<td>Satin Chromium Plated</td>
</tr>
<tr>
<td>630</td>
<td>Satin Stainless Steel</td>
</tr>
<tr>
<td>689</td>
<td>Aluminum Painted</td>
</tr>
<tr>
<td>GREY</td>
<td>Grey</td>
</tr>
<tr>
<td>US26D</td>
<td>Chromium Plated, Dull</td>
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<tr>
<td>US32D</td>
<td>Stainless Steel, Dull</td>
</tr>
</tbody>
</table>

### Option List

<table>
<thead>
<tr>
<th>Code</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>R</td>
<td>Full Size Rounded Plastic Cover</td>
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<tr>
<td>CD</td>
<td>Cylinder Dogging</td>
</tr>
<tr>
<td>FL</td>
<td>Fire Exit Hardware</td>
</tr>
<tr>
<td>HC</td>
<td>Hurricane Code Device</td>
</tr>
<tr>
<td>WS</td>
<td>Wind Storm Listed (Miami-Dade/Florida)</td>
</tr>
<tr>
<td>B4E</td>
<td>BEVELED 4 EDGES - KICK PLATES</td>
</tr>
<tr>
<td>CSK</td>
<td>COUNTER SINKING OF KICK PLATES</td>
</tr>
<tr>
<td>NRP</td>
<td>NON-REMOVEABLE PIN HINGE</td>
</tr>
</tbody>
</table>

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Standard Interior hollow metal door frames.
2. Standard hollow metal frames for interior windows.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.
C. Samples for Initial Selection: For units with factory-applied color finishes.
D. Samples for Verification: For each type of exposed finish required.
E. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.3 QUALITY ASSURANCE

A. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL 10C.

B. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to UL 9. Label each individual glazed lite.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Amweld Building Products, LLC.
2. Benchmark; a division of Therma-Tru Corporation.
3. Ceco Door Products; an Assa Abloy Group company.
4. Curries Company; an Assa Abloy Group company.
5. Steelcraft; an Ingersoll-Rand company.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS, Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS, Type B.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 (ZF120) metallic coating.

D. Frame Anchors: ASTM A 591/A 591M, Commercial Steel (CS), 40Z (12G) coating designation; mill phosphatized.

1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Mineral-Fiber Insulation: ASTM C 665, Type I.

G. Glazing: Division 8 Section "Glazing."

H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat.

2.3 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8.

B. Interior Frames: Fabricated from cold-rolled steel sheet.

1. Fabricate frames with mitered or coped corners.
2. Fabricate frames as full profile welded unless otherwise indicated.
3. Frames for Level 1 Steel Doors: 0.042-inch thick steel sheet.
4. Frames for Borrowed Lights: 0.042-inch- thick steel sheet.


2.4 FRAME ANCHORS

A. Jamb Anchors:
   1. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

B. Anchors: Formed from same material as frames, not less than 0.042 inch thick, and as follows:
   1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
   2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch height adjustment. Terminate bottom of frames at finish floor surface.

2.5 STOPS AND MOLDINGS

A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch thick, same material as door face sheet.

B. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch thick, same material as frames.

2.6 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Ceiling Struts: Minimum 1/4-inch-thick by 1-inch- wide steel.

2.7 FABRICATION

A. Tolerances: Fabricate hollow metal work to tolerances indicated in SDI 117.

B. Hollow Metal Frames: Where frames are fabricated in sections, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
   1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
   2. Sidelight Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

4. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.

5. Jamb Anchors: Provide number and spacing of anchors as follows:

   a. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

      1) Three anchors per jamb up to 60 inches high.
      2) Four anchors per jamb from 60 to 90 inches high.
      3) Five anchors per jamb from 90 to 96 inches high.
      4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
      5) Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.

   b. Compression Type: Not less than two anchors in each jamb.

6. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers.

   b. Double-Door Frames: Two door silencers.

C. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."

   1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
   2. Reinforce doors and frames to receive nontemplated, mortised and surface-mounted door hardware.
   3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
   4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 16 electrical Sections.

D. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

   1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow metal work.
   2. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
   3. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
   4. Provide loose stops and moldings on inside of hollow metal work.
   5. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.
2.8 STEEL FINISHES

A. Prime Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hollow Metal Frames: Comply with ANSI/SDI A250.11.
   1. Set frames accurately in position, plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
      a. At fire-protection-rated openings, install frames according to NFPA 80.
      b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
      c. Install frames with removable glazing stops located on secure side of opening.
      d. Install door silencers in frames before grouting.
      e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
      f. Check plumbness, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
      g. Field apply bituminous coating to backs of frames that are filled with grout containing antifreezing agents.
   2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
      a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.
   4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to overhead structural supports or substrates above frame 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. Provide adjustable wedged or bolted anchorage to frame jamb members.
   5. Installation Tolerances: Adjust hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

B. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with hollow metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.2 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

C. Metallic-Coated Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

END OF SECTION 08 1113
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wood veneer faced flush doors.
   2. Factory finishing.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 08 1113 Interior Steel Door Frames
   3. Section 08 7100 - Door Hardware.
   4. Section 08 8000 - Glazing.

1.2 REFERENCES

A. Architectural Woodwork Institute/Architectural Woodwork Manufacturers of Canada/Woodwork Institute (AWI/AWMAC/WI) - Architectural Woodwork Standards.


D. Underwriters Laboratories (UL):
   1. 10B - Standard for Fire Tests of Door Assemblies.
   2. 10C - Standard for Positive Pressure Fire Tests of Door Assemblies.

E. Window and Door Manufacturers Association (WDMA) - I.S.1A - Industry Standard for Architectural Flush Wood Doors.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Show locations, elevations, dimensions, [fire] [acoustical] ratings, and preparation for hardware.
   2. Samples:
      a. 6 x 6 inch door samples showing edges, core, and faces.
      b. 12 x 12 inch veneer samples showing specified stain color and finish.
   3. Warranty: Sample warranty form.

B. Quality Control Submittals:
   1. Certificates of Compliance: Manufacturer's certification that doors comply with specified acoustical requirements.

1.4 QUALITY ASSURANCE

A. Fire Door Construction: Conform to UL 10B.

B. Installed Fire Rated Door Assembly: Conform to NFPA 80.

1.5 DELIVERY, STORAGE AND HANDLING

A. Package doors in heavy plastic with identifying marks; slit plastic wrap on site to permit ventilation, but do not remove from plastic until ready to install.
B. Do not deliver doors until building is substantially water and weather tight.

C. Store doors flat and level, with spacers between doors to allow for air circulation, in protected, dry area.

D. Environmental Requirements: Maintain following conditions in building for minimum 7 days prior to, during, and after installation of doors:
   1. Temperature: 60 to 80 degrees F.
   2. Humidity: 43 to 70 percent.

1.6 WARRANTIES
A. Furnish manufacturer’s 5 year warranty providing coverage against defects in materials and workmanship and warpage beyond specified amount.

PART 2 PRODUCTS

2.1 MANUFACTURERS
A. Acceptable Manufacturers:
   1. Algoma Hardwoods, Inc. (www.algomahardwoods.com)
   2. Eggers Industries. (www.eggersindustries.com)
   4. Oshkosh Door Co. (www.oshkoshdoor.com)
   5. VT Industries, Inc. (www.vtindustries.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS
A. Flush Wood Doors:
   1. AWI/AWMAC/WI Architectural Woodwork Standards, Section 9.
   2. Core type:
      a. Solid, fire rated: Fire-Resistant Composite Core.
      b. Solid, non rated: Particleboard or Medium Density Fiberboard.
      c. Hollow: Hollow Grid.
   3. Wood veneers faces: Red Oak species, rift cut, of quality suitable for transparent finish.
   4. Glazing beads: Solid wood of species and cut to match face veneers.
   5. Adhesives: Water Resistant type.

2.3 ACCESSORIES
A. Glass and Glazing Accessories: Specified in Section 08 8000.

2.4 FABRICATION
A. Fabricate doors in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 9.
   1. Grade: Premium.
   3. Edge Type: Solid wood.
   4. Number of plies: 5.

B. Prefitting; fit doors to frames at factory with following clearances:
   1. Fire rated doors:
      a. Width: Cut lock edge only; 3/16 inch maximum.
      b. Height: Cut bottom edge only; 1 inch maximum.
   2. Non-rated doors:
      a. Width: Cut hinge and lock edges equally.
b. Height: Cut bottom edge only; maximum 3/4 inch.

3. Edge clearances:
   a. Jambs and head: 1/8 inch maximum between door and frame.
   b. Sills without thresholds: 1/8 inch maximum between door and top of finish floor.
   c. Sills with thresholds: 1/4 inch maximum between door and top of threshold.
   d. Meeting stiles of pairs: 1/8 inch maximum between doors.

4. Lock edge: Bevel 1/8 inch in 2 inches.

C. Premachining: Machine doors at factory to receive hardware specified in Section 08 7100.

2.5 FINISHES

A. Factory Finishing:
   1. Factory finish doors in accordance with AWI/AWMAC/WI Architectural Woodwork Standards, Section 5.
   2. Color: To be selected from manufacturer’s full color range.

PART 3 EXECUTION

3.1 PREPARATION

A. Condition doors to average humidity that will be encountered after installation.

3.2 INSTALLATION

A. Install doors in accordance with AWI/AWMAC/WI Architectural Woodwork Standards.

B. Install doors plumb and level.

C. If field cutting for height is necessary, cut bottom edge only, 3/4 inch maximum.

D. Seal field cut surfaces with same finish as door faces.

E. Install door hardware in accordance with Section 08 7100.

F. Install glass as specified in Section 08 8000.

G. Installation Tolerances:
   1. Warp: Maximum 1/4 inch in any 3'-0" x 7'-0" portion of door, measured with taut string or straight edge on concave face of door.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aluminum entrance doors and frames.
   2. Aluminum framed glazed storefronts.
   3. Glass infill panels.
   4. Door hardware.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 07 9200 - Joint Sealers.
   3. Section 08 7100 - Door Hardware.
   4. Section 08 8000 - Glazing.

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA):
   1. 611 - Voluntary Specification for Anodized Architectural Aluminum.

B. American National Standards Institute/Builders Hardware Manufacturers Association (ANSI/BHMA) A156.3 - Exit Devices.

C. American Society of Civil Engineers (ASCE) 7 - Minimum Design Loads for Buildings and Other Structures.

D. ASTM International (ASTM):

E. Underwriters Laboratories (UL) 305 - Safety Panic Hardware.
1.3 SYSTEM DESCRIPTION

A. Design Requirements: Design [exterior] systems to withstand:
   1. Design wind pressure in accordance with structural drawings with maximum allowable
deflection of L/175, tested in accordance with ASTM E330.
   2. Movement caused by an ambient temperature range of 120 degrees F and a surface
temperature range of 160 degrees F.

B. Performance Requirements:
   1. Air infiltration, tested to ASTM E283.
      a. Entrances:
         1) Single door: Maximum 0.5 CFM per minute per linear foot of perimeter crack, at
            static pressure differential of 6.24 PSF.
         2) Pairs of doors: Maximum 1.0 CFM per minute per linear foot of perimeter crack, at
            static pressure differential of 6.24 PSF.
      b. Storefront: 0.06 CFM per square foot of fixed area at static pressure differential of 6.24
         PSF.
   2. Water infiltration: No uncontrolled water leakage, tested to ASTM E331 at minimum test
      pressure of 15.0 PSF for outswing doors and storefront.
   3. Uniform structural loading: No glass breakage or permanent damage to fasteners or system
      components, tested to ASTM E330 at 1.5 times design pressure.
   4. Thermal transmittance due to conduction (Uc): Maximum 0.60, tested to AAMA 1503 on two 6'-
      0" x 6'-0" units with 1 inch clear insulating glass.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances,
      trim, sealers, hardware, and accessories.
   2. Samples:
      a. 12 inch long aluminum framing system samples showing profile and finish.

B. Quality Control Submittals:
   1. Test Reports: Certified results of previous tests by a recognized independent laboratory
      substantiating compliance with specified design and performance criteria, current within past 5
      years.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 10 years experience in work of this Section.

B. Conform to applicable accessibility code for locating hardware and for door opening force
   requirements.

1.6 WARRANTIES

A. Furnish manufacturer’s 10 year warranty providing coverage against water leakage through storefront
   system and reduction of performance.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. EFCO Corporation. (www.efcocorp.com)
   2. Kawneer Co., Inc. (www.kawneer.com)
   3. Oldcastle BuildingEnvelope. (www.oldcastlebe.com)
   4. Tubelite, Inc. (www.tubeliteinc.com)
YKK AP America, Inc. (www.ykkap.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Aluminum:
   1. Extrusions: ASTM B221, 6063-T5 alloy and temper.
   2. Sheet: ASTM B209, alloy and temper best suited to application.

2.3 COMPONENTS

A. Entrances Doors: Medium stile configuration with nominal 3-1/2 inch vertical stiles and top rail and 6-1/2 inch bottom rail.
B. Storefront: Flush glazing system designed to receive 1-5/16 inch glass by means of elastomeric gaskets and/or wet sealant; 2-1/2 inch face width x 5 inch depth, center multi-plane glass application.
C. Door Hardware:
   1. Butt hinges: Manufacturer's standard, full mortise, five knuckle, ball bearing type with non rising pins. Provide non-removable pins at exterior outswinging doors.
   2. Closers:
      a. Overhead exposed, single acting, adjustable closing and latching speed and backcheck, 105 degree hold open.
      b. Adjustable opening force and delayed closing in accordance with applicable accessibility code.
   3. Deadlocks: Keyed outside x thumbturn inside; cylinders specified in Section 08 7100.
   4. Push and pull: To be selected from manufacturer's full range of selections.
   5. Thresholds: 1/2 inch high, aluminum, saddle profile, handicap accessible.
   6. Door stops: Floor mounted; aluminum housing with resilient bumper.

2.4 ACCESSORIES

A. Fasteners:
   1. Series 300 stainless steel for wet locations and exposed fasteners.
   2. Stainless or fluoropolymer coated steel for other locations.
B. Joint Sealers: Specified in Section 07 9200.
C. Glass and Glazing Accessories: Specified in Section 08 8000.
D. Weatherstripping: Replaceable, resilient bulb type.

2.5 FABRICATION

A. Fabricate with minimal clearances and shim spaces around perimeter.
B. Accurately fit and secure joints and intersections. Make joints flush, hairline, and weathertight.
C. Fabricate in largest practical units.
D. Conceal fasteners and attachments from view.
E. Fabricate fascias, covers, closures, flashings, and trim members from same material as storefront.
F. Doors:
   1. Through bolted construction.
2. Provide weatherstripping at door head, jambs, meeting stiles, and sills.
3. Prepare with internal reinforcements for door hardware.

2.6 FINISHES
   A. Aluminum: AAMA 611, Architectural Class I anodized to 0.0007 inch minimum thickness, clear color.
   B. Apply bituminous coating to aluminum surfaces in contact with cementitious materials.

PART 3 EXECUTION

3.1 INSTALLATION
   A. Install in accordance with manufacturer's instructions and approved Shop Drawings.
   B. Install components plumb and level, in proper plane, free from warp and twist.
   C. Anchor to supporting construction.
   D. Set thresholds and sill members exposed to weather in mastic and secure.
   E. Install hardware using templates provided by manufacturer.
   F. Install glass and accessories in accordance with Section 08 8000.
   G. Installation Tolerances:
      1. Maximum variation from plumb or level: 1/8 inch in 3 feet or 1/4 inch in any 10 feet, whichever is less.
      2. Maximum misalignment of members abutting end to end: 1/32 inch.
      3. Sealant space between framing members and adjacent construction: 1/2 inch plus or minus 1/8 inch.

3.2 FIELD QUALITY CONTROL

3.3 ADJUSTING
   A. Adjust hardware for smooth operation.
   B. Adjust doors to operate with maximum opening forces in accordance with applicable accessibility code.
   C. Touch up minor scratches and abrasions to match original finish.
   D. Adjust weatherstripping to contact appropriate surfaces and form weather seal.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Glass for other sections referencing this Section.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA) 800 - Voluntary Specifications and Test Methods for Sealants.


C. American Society of Civil Engineers (ASCE) 7 - Minimum Design Loads for Buildings and Other Structures.

D. ASTM International (ASTM):


F. Glass Association of North America (GANA):
G. Insulating Glass Manufacturers Alliance (IGMA):
   1. SIGMA TM-3000 - Glazing Guidelines for Sealed Insulating Glass Units.

H. National Fenestration Rating Council (NFRC):
   1. 100 - Procedure for Determining Fenestration Product Thermal Properties.

1.3 SYSTEM DESCRIPTION

A. Glass Thicknesses:
   1. Indicated thicknesses are minimums; select actual glass thicknesses by analyzing loads and conditions.
   2. Size glass to withstand positive and negative wind pressure acting normal to plane in accordance with Building Code as measured in accordance with ASTM E330.
   3. Provide glass in thicknesses and strengths to meet or exceed following criteria:
      a. Comply with ASTM E1300.
      b. Probability of breakage for vertical glazing: 8 lites per 1000 for lites set within 15 degrees of vertical and under wind load for load duration of 3 seconds.
      c. Thickness of tinted glass: Provide same thickness for each tint color for all applications.

B. Thermal and Optical Performance Properties: Provide glass meeting specified performance properties, based on manufacturer's published test data for units of thickness indicated:
   1. U-factor: Per NFRC 100 expressed as Btu/square foot x hour x degree F.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Descriptive data and performance attributes for insulated glass.
   2. Samples:
      a. 12 x 12 inch glass samples [except clear].
      b. 1/4 x 1/4 x 3 inch long sealant and glazing compound samples showing available colors.
   3. Warranty: Sample warranty form.

B. Quality Control Submittals:
   1. Test Report: Preconstruction adhesion and compatibility test report from glazing sealant manufacturer, based on submitted samples or acceptable data from previous testing of current formulations with similar products.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 10 years experience in work of this Section.

B. Regulatory Requirements:
   1. Provide safety glass for locations subject to human impact as required by Building Code.

C. Perform Work in accordance with GANA Laminated Glass Design Guide and IGMA TB-3001.

D. Fire Rated Glass Assemblies: Conform to ASTM E119.

1.6 PROJECT CONDITIONS
A. Perform glazing when ambient temperature is above 40 degrees F.

B. Perform glazing on dry surfaces.

1.7 Warranties

A. Insulating Glass Units: Provide manufacturer’s 10 year warranty against material obstruction of vision through unit due to:
1. Intrusion of dust or moisture.
2. Internal condensation.
3. Film formation on internal glass surfaces caused by failure of hermetic seal except failure caused in whole or in part by breakage or fracturing of any portion of glass surface.

B. Glass Coatings: Provide manufacturer’s 10 year warranty against peeling, cracking, or deterioration of coating under normal conditions.

C. Laminated Glass Units: Provide manufacturer’s 10 year warranty against manufacturing defects resulting in edge separation, delamination, or material obstruction of vision through glass surface.

D. Mirrors: Provide manufacturer’s 10 year warranty against silver spoilage resulting from manufacturing defects.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Glass:
1. Guardian Industries Corp. (www.guardian.com)
2. Oldcastle BuildingEnvelope. (www.oldcastlebe.com)
4. PPG Industries, Inc. (http://www.ppg.com/)
5. Viracon, Inc. (www.viracon.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS - GLASS

A. Clear Glass: ASTM C1036, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select.

B. Clear Tempered Glass: ASTM C1048, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select, Kind FT fully tempered.

C. Clear Heat Strengthened Glass: ASTM C1048, Type 1 transparent flat, Class 1 clear, Quality q3 glazing select, Kind HS heat strengthened.

D. Tinted Glass:
1. Type: ASTM C1036, Type 1 transparent flat, Class 2 tinted heat absorbing and light reducing, Quality q3 glazing select.
2. Color: Green

E. Tinted Tempered Glass:
1. Type: ASTM C1048, Type 1 transparent flat, Class 2 tinted heat absorbing and light reducing, Quality [q3 glazing select,] [____,] Kind FT fully tempered.
2. Color: Green.

F. Tinted Heat Strengthened Glass:
1. Type: ASTM C1048, Type 1 transparent flat, Class 2 tinted heat absorbing and light reducing, Quality Kind HS heat strengthened.
2. Color: Green.

G. Mirror Glass: ASTM C1036, Type I transparent flat, Class 1 clear, Quality q1 mirror select.

2.3 MATERIALS - FIRE-RATED GLASS

A. Fire Rated [Safety] Glass:
1. Type: Specially tempered glass, clear, of fire resistance ratings indicated.

2.4 ACCESSORIES

A. Setting Blocks: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone; 80 to 90 Shore A durometer hardness.

B. Spacers: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone; 50 to 60 Shore A durometer hardness.

C. Glazing Gaskets:
1. Dense compression gaskets: ASTM C864, neoprene or EPDM, or ASTM C1115, silicone or thermoplastic polyolefin rubber, molded or extruded shape to fit glazing channel retaining slot; black color.
2. Soft compression gaskets: ASTM C509, Type II, black, molded or extruded, neoprene, EPDM, silicone or thermoplastic polyolefin rubber, of profile and hardness required to maintain watertight seal; black color.

D. Contact Sealant (shop glazed):
1. Type: ASTM C1184, multi component, high modulus, neutral chemical curing silicone glazing and curtain wall sealant.
2. Movement capability: 12 percent in extension and compression.
3. Compatible with glass unit edge seals; tested to ASTM C1294.
4. Color: To be selected from manufacturer's full color range.

E. Contact Sealant (field glazed):
1. Type: Single component, medium modulus, neutral moisture curing silicone sealant; ASTM C1184 and ASTM C920, Type S, Grade NS, Class 25, Use NT, M, G and A.
3. Compatible with glass unit edge seals; tested to ASTM C1294.
4. Color: To be selected from manufacturer's full color range.

F. Weatherseal Sealant:
1. Type: Single component, low modulus, neutral moisture curing silicone sealant; ASTM C920, Type S, Grade NS, Class 25, Use NT, M, G and A.
3. Compatible with glass unit edge seals; tested to ASTM C1294.
4. Color: To be selected from manufacturer's full color range.

G. Glazing Sealant: ASTM C920, Type S, Grade NS, Class 25; single component silicone, low modulus, non sag, color to be selected from manufacturer's full color range.

H. Sealant Backing: ASTM C1330, Type O, size and density to control glazing sealant depth and produce optimum glazing sealant performance.

I. Primer: As recommended by glazing sealant manufacturer.

J. Glazing Tape: ASTM C1281 and AAMA 800; butyl based elastomeric tape with integral resilient tube spacer, 10 to 15 Shore A durometer hardness, black color, coiled on release paper; widths required for installation.
K. Mirror Adhesive: Adhesive setting compound, produced specifically for setting mirrors by spot application method.

L. Mirror Frame: Roll formed stainless steel channel, No. 4 satin finish, 1/2 x ½ inch, 18 gage, mitered corners.

M. Laminating Film: Polyvinyl butyral sheet, thickness as required for impact resistance (small and large missile), clear.

2.5 FABRICATION

A. Annealed Glass: Comply with ASTM C1036.

B. Heat Strengthened Tempered Glass:
   2. Process in horizontal position so that inherent roller distortion will run parallel to building floor lines after installation.

C. Sealed Insulating Glass:
   2. Fabricate spacer bar frame of tubular aluminum filled with desiccant.
   3. Bond spacer bar frame to glass panes with twin primary seals.
   4. Fill space outside frame to glass edge with elastomeric sealant.

D. Laminated Glass:
   2. Laminate glass with laminating film by manufacturer's standard heat and pressure process.
   3. Cut glass to required size at factory.
   4. Discard glass with voids, delamination, or entrapped dirt or foreign matter.

E. Low-E Coated Glass: Apply low-emissivity coating to scheduled glass surface.

F. Mirror Glass:
   1. Apply one coat of silver, one coat of electroplated copper, and one coat of organic mirror backing compound to back surface of glass.
   2. Isolate glass from frame with resilient, waterproof padding.


H. Glass Identification:
   1. Apply manufacturer's label indicating type and thickness to each light of glass. Show position of exterior face when installed, where applicable.
   2. Etch manufacturer's label on each light of tempered glass.

I. Source Quality Control:
   1. Preconstruction adhesion and compatibility testing:
      a. Perform adhesion test including ultraviolet exposure through glass on production samples of metals and glass in accordance with ASTM C794.
      b. Test glass units, glazing materials, and glass framing members with specified finish for sealant compatibility, priming, and preparation requirements for optimum adhesion and performance.

PART 3 EXECUTION
3.1 PREPARATION
   A. Clean glazing rabbets; remove loose and foreign matter.
   B. Remove protective coatings on metal surfaces.
   C. Clean glass just prior to installation.

3.2 INSTALLATION - GENERAL
   A. Install glass in accordance with glass manufacturer's instructions.
   B. Maintain manufacturer's recommended edge and face clearances between glass and frame members.

3.3 INSTALLATION - STRUCTURAL SILICONE GLAZING METHOD
   A. Mask aluminum and glass surfaces adjacent to sealant pockets.
   B. Install temporary glass retainers to align faces of glass.
   C. Apply contact sealant; completely fill pockets. Tool joints and remove masking tape before sealant skim cure begins.
   D. Allow sealant to cure minimum time required by manufacturer.
   E. Remove temporary glass retainers.
   F. Insert joint backing to fill void between glass unit edges and glass spacer.
   G. Mask both sides of glass for full length of joint.
   H. Apply weatherseal sealant; tool to smooth, slightly concave profile.

3.4 INSTALLATION - SILICONE GLAZING METHOD
   A. Mask both sides of joint for full length.
   B. Install temporary glass retainers to align faces of glass.
   C. Provide temporary joint backing for one side of joint.
   D. Apply sealant to completely fill spaces; tool to smooth, slightly concave surface.
   E. Allow sealant to cure minimum time required by manufacturer. Remove temporary backing and fill voids with additional sealant.

3.5 INSTALLATION - GASKET GLAZING METHOD
   A. Fabricate gaskets to fit openings; allow for stretching of gaskets during installation.
   B. Set soft compression gasket against fixed stop or frame with bonded miter cut joints at corners.
   C. Set glass centered in openings on setting blocks.
   D. Install removable stops and insert dense compression gaskets at corners, working toward centers of glass, compressing glass against soft compression gaskets to produce weathertight seal.
   E. Seal joints in gaskets.
3.6 INSTALLATION - PRESSURE GLAZING METHOD

A. Set glass unit in opening as recommended by system manufacturer.
B. Tighten fasteners simultaneously at rate recommended by manufacturer to avoid unequal point pressures on glass.
C. Torque fasteners to achieve required pressure against glass. Do not over tighten.

3.7 INSTALLATION - SEALANT GLAZING METHOD

A. Apply sealant to full depth of permanent stops.
B. Press glass into sealant with slight lateral movement to ensure adhesion.
C. Apply sealant to full depth of removable stops. Secure stops in position, forcing contact with sealant bead and completely filling joint.

3.8 INSTALLATION - SEALANT AND TAPE GLAZING METHOD

A. Apply tape to permanent stops, projecting slightly above sight line.
B. Press glass into contact with tape.
C. Install removable stops with spacer shims between stop and glass.
D. Fill gap between removable stop and glass with glazing sealant.
E. Trim protruding tape edges.

3.9 INSTALLATION - MIRRORS

A. Support mirrors on concealed hanger brackets. Anchor rigidly to wall construction.
B. Place plumb and level without distortion.

3.10 PROTECTION

A. After installation, mark glass with an ‘X’ using removable plastic tape.

3.11 SCHEDULE

A. Type 1: Small and large missile impact resistant
   1. Description:
      a. Outboard lite: 1/4 inch thick tinted glass, tempered where required, with low-e coating on No. 2 surface.
      b. Inboard lite: 9/16 inch thick clear laminated glass, tempered where required.
   2. Total unit thickness: 1 5/16 inch.
   3. Performance characteristics: Equal to “Solarban 60”

B. Type 2:
   1. Description: 1/4 inch thick clear tempered glass.
   2. Locations: Interior doors and glazed openings at locations subject to human impact, excluding fire-rated assemblies.

C. Type 3:
1. Description: 1/4 inch thick clear glass.
2. Locations: Interior glazed openings at locations not subject to human impact, excluding fire-rated assemblies.

D. Type 4:
1. Description: 1/4 inch thick clear fire-rated safety glass.
2. Locations: Interior fire-rated glazed openings at doors and other locations subject to human impact.

E. Type 5:
1. Description: 1/8 inch thick clear mirror glass.
2. Locations: Toilet room mirrors.

F. Type 6:
1. Description: 9/16 inch thick clear laminated impact resistant.
2. Locations: Interior doors and glazed openings at Gymnasium locations subject to human impact, excluding fire-rated assemblies.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Metal stud interior partition framing.
   2. Metal interior wall furring.
   3. Suspended metal channel soffit and ceiling framing.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   3. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.
   7. C645 - Standard Specification for Non-Load (Axial) Bearing Steel Studs, Runners (Track), and Rigid Furring Channels for Screw Application of Gypsum Board.
   8. C754 - Standard Practice for Installation of Steel Framing Members to Receive Screw-Attatched Gypsum Wall board, Backing Board, or Water-Resistant Backing Board.


C. Steel Stud Manufacturer's Association (SSMA)(www.ssma.com - Member Directory.

D. Underwriters Laboratories, Inc. (UL) - Fire Resistance Directory.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Illustrate framing types, gages, and locations.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 10 years experience in work of this Section.

B. Fire Resistance Ratings:
   1. Construct assemblies to achieve fire resistance ratings indicated on Drawings, in accordance with applicable GA or UL design number.
2. If requirements of assembly numbers referenced conflict with Contract Document requirements, conform to assembly requirements.

C. Acoustic Ratings: Construct assemblies to achieve acoustic ratings indicated on Drawings, tested to ASTM E90 and classified in accordance with ASTM E413.

D. Deflection Limits:
   1. Limit deflection of partitions to following limits, based on 5 PSF uniform design load.
      a. Partitions to receive tile: L/240.
      b. Other partitions: L/120.
      c. If partition height exceeds stud manufacturer’s limiting height for applicable loading and deflection, install bracing above ceiling, decrease stud spacing, or increase stud gage.
   2. Limit deflection of ceilings to L/360.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Allsteel and Gypsum Products, Inc. (www.allsteelproducts.com)
   2. Consolidated Fabricators Corp. (www.confabbpd.com)
   3. Craco Manufacturing., Inc. (www.cracometals.com)
   5. Design Shapes in Steel.
   6. Frametek Steel Products. (www.frameteksteel.com)
   7. Olmar Supply Inc. (www.olmarsupply.com)
   8. Quail Run Building Materials, Inc. (www.qrbm.com)
   9. SCAFCO Corporation. (www.scafco.com)
  11. United Metal Products, Inc. (www.unitedmetalproducts.info)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Steel: A653/A653M or ASTM A1003/1003M, Class G40 hot dip galvanized.

2.3 COMPONENTS

A. Provide components in accordance with ASTM C645.

B. Studs: Non-load bearing roll-formed steel, SSMA stud profile, C-shaped, punched for utility access.

C. Top and Bottom Tracks:
   1. Same material and finish as studs, C-shaped.
   3. Deep leg track: SSMA deep stud track profile, 2 inch legs.
   4. Deflection track: Deep leg track with slotted screw holes; permit plus or minus 1/2 inch movement of overhead structure without damage to partition.

D. Suspended Ceiling Framing:
   1. ASTM C635; manufactured specifically for suspended gypsum board ceiling applications.
   2. Tees: Double web design; 1-1/2 inches high with 1-3/8 inch wide knurled faces, with interlocking ends and punched holes for cross tees and hanger wires.
E. Wall Furring Channels: Hat shaped, depth as indicated, minimum 25 gage base steel thickness.

2.4 ACCESSORIES

A. Fasteners: 3/8 inch long pan head screws.

   1. Hanger wire: 8 gage base steel thickness.
   2. Tie wire: 18 gage base steel thickness, soft annealed.

C. Wall Furring Brackets: Galvanized steel, two piece adjustable type.

D. Furring Channel Clips: Galvanized steel.

PART 3 EXECUTION

3.1 INSTALLATION OF PARTITION FRAMING

A. Install in accordance with ASTM C754 and manufacturer's instructions.

B. Attach top and bottom tracks at ends and 24 inches on center maximum.

C. Position studs vertically in tracks, spaced maximum 16 inches on center unless indicated otherwise.

D. Install deflection track at head of partitions extending to structure. Cut studs 1/2 inch shorter than required length and fit into top track. Fasten studs to top track in manner permitting track movement.

E. Locate studs maximum 2 inches from door frames and abutting construction.

F. Use heavier gage studs or double studs on both sides of openings in partitions.

G. Install horizontal track as header above openings in partitions. Install studs from header to top track.

H. Brace furred partitions with adjustable bracket located at mid height.

I. Provide wood or metal bracing in partitions to receive and support fixtures, trim, accessories and other applied items.

J. Brace ceiling height partitions to structure at 48 inches on center maximum.

3.2 INSTALLATION OF CEILING FRAMING

A. Install in accordance with ASTM C636 and manufacturer’s instructions.

B. Space hanger wires maximum 48 inches on center. Install additional hangers where required to support light fixtures and ceiling supported equipment.

C. Do not suspend hangers directly from metal deck. Attach steel channel horizontally to adjacent framing members; place hanger at regular spacing.

D. Hang suspension system independent of walls, columns, ducts, pipes, and conduit.

E. Where ducts or other equipment prevent regular spacing of hangers:
   1. Reinforce nearest related hangers to span extra distance, or:
2. Suspend steel channel horizontally beneath duct or equipment; place hanger at regular spacing.

F. Install main tees at maximum 48 inches on center. Fully engage end locks.

G. Install cross tees perpendicular to main tees to form 24 x 48 inch modules. Lock cross tees to main tees.

3.3 INSTALLATION OF WALL FURRING

A. Install in accordance with ASTM C754 and manufacturer's instructions.

B. Space channels 24 inches on center maximum and within 3 inches of corners; secure at maximum 24 inches on center with fasteners staggered on alternating flanges.

C. Nest channels minimum 8 inches at splices; secure with two fasteners in each flange.

END OF SECTION
SECTION 09 2900
GYPSUM BOARD

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Acoustical insulation.
   2. Gypsum board.
   3. Taping and bedding of gypsum board.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.
   2. Section 07 9200 - Joint Sealers.

1.2 REFERENCES

A. ASTM International (ASTM):

B. Gypsum Association (GA):
   2. GA-216 - Recommended Specifications for the Application and Finishing of Gypsum Board.

C. Underwriters Laboratories, Inc. (UL) - Fire Resistance Directory.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Illustrate panel product types, thicknesses, and locations; acoustical insulation; and accessories.

1.4 QUALITY ASSURANCE

A. Fire Resistance Ratings:
   1. Construct assemblies to achieve fire resistance ratings indicated on Drawings, in accordance with referenced GA or UL design number.
   2. If requirements of assembly numbers referenced conflict with Contract Document requirements, conform to assembly requirements.

B. Acoustic Ratings: Construct assemblies to achieve acoustic ratings indicated on Drawings, tested to ASTM E90 and classified in accordance with ASTM E413.
1.5 PROJECT CONDITIONS

A. Do not install gypsum board until building is substantially weathertight.

B. Maintain temperature in spaces in which work is being performed above 50 degrees F during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Gypsum Panels:
   1. CertainTeed Gypsum, Inc. (www.certainteed.com)
   2. GP Gypsum Corporation. (www.gp.com)
   4. USG Corporation. (www.usg.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS - GYPSUM PANELS

A. Regular and Abuse-Resistant Gypsum Board: ASTM C1396; 48 inches wide x 5/8 inch thick, maximum practical length, tapered edge.

B. Fire Resistant Gypsum Board: ASTM C1396, Type X; 48 inches wide x 5/8 inch thick, maximum practical length, tapered edge; apply to fire rated assemblies.

2.3 ACCESSORIES

A. Fasteners: ASTM C1002, Type S screws, minimum 5/8 inch penetration into framing.

B. Acoustical Insulation:
   1. ASTM C665, Type I, glass fiber composition, unfaced.
   2. Free from urea-formaldehyde resins, phenol, acrylics, and artificial colors.

   1. Material: Formed steel, minimum 26 gage core steel, hot dip galvanized finish, expanded flanges.

D. Acoustical Sealer: Specified in Section 07 9200.

E. Joint Treatment Materials:
   1. Reinforcing tape and joint compound; ASTM C475.

PART 3 EXECUTION

3.1 INSTALLATION OF GYPSUM PANELS

A. Install panels and accessories in accordance with ASTM C754, GA-216, and manufacturer’s instructions.

B. Accurately cut panels to fit around openings and projections. Do not tear face paper or break gypsum core.

C. Apply abuse-resistant panels from floor to 48” above finished floor in all locations.

D. Apply panels at non fire-rated assemblies in most economical manner, with ends and edges occurring over supports.
E. Apply panels at fire-rated assemblies as required by design assembly.

F. Stagger joints on opposite sides of partitions.

G. Do not locate joints to align with edges of openings unless a control joint is installed.

H. Mechanically fasten panels to framing. Place fasteners minimum 3/8 inch from edges of panels; drive heads slightly below surface. Stagger fasteners at abutting edges.

I. Apply face layer of double layer applications with joints offset from those in base layer; secure with mechanical fasteners to framing or with adhesive to base layer.

J. Treat cut edges and holes in moisture resistant gypsum board with joint sealer.

K. Where recessed items occur in fire rated partitions, box item on all sides with gypsum board as required to maintain continuity of fire rating.

3.2 INSTALLATION OF ACOUSTICAL PARTITIONS

A. Extend acoustical partitions past intersecting non-acoustical partitions.

B. Install acoustical insulation:
   1. Butt to framing members and adjacent construction.
   2. Carry around pipes, wiring, outlets, and other construction without voids.
   3. Press against one gypsum board surface to form slight air space on opposite side.

C. Seal acoustical partitions at perimeter and around penetrations:
   1. Apply continuous bead of sealer between gypsum panel edges and adjacent construction.
   2. Seal space between gypsum panels at control joints, prior to installing metal control joint.
   3. Apply sealer to penetrations through partitions.

3.3 INSTALLATION OF ACOUSTICAL INSULATION ABOVE CEILINGS

A. Install acoustical insulation in continuous layer. Butt tightly to adjacent insulation and to other construction.

B. Carry over pipes, wiring, boxes, and other construction without voids.

3.4 INSTALLATION OF ACCESSORIES

A. Install in accordance with manufacturer's instructions.

B. Install corner reinforcement at outside corners. Use single lengths where length of corner does not exceed standard length.

C. Install casings where indicated and where gypsum board abuts dissimilar materials or stops with edge exposed.

D. Install control joints at walls and partitions:
   1. At changes in backup material.
   2. At maximum 30 feet on center.
   3. Above both jambs of openings in partitions.

3.5 JOINT TREATMENT

A. Treat joints and fasteners in gypsum board in accordance with GA-214.

B. Levels of Finish:
   1. Surfaces in plenums and janitor closets: Level 1 finish.
2. Surfaces to receive knock-down texture and paints: Level 4 finish.

END OF SECTION
PART 1   GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Acoustical panels.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):


C. Underwriters Laboratories, Inc. (UL) - Fire Resistance Directory.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Samples:
      a. 12 x 12 inch acoustical panel samples.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 5 years experience in work of this Section.

1.5 PROJECT CONDITIONS

A. Environmental Requirements: Install in approximately same conditions of temperature and humidity as will prevail after installation.

1.6 MAINTENANCE

A. Extra Materials: One unopened carton of each acoustical panel.

PART 2   PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers - Acoustical Units:
   1. Armstrong World Industries, Inc. (www.armstrong.com)

B. Substitutions: Not permitted.

2.2 MATERIALS

A. Acoustical Panels:
   1. Acoustical Ceiling Tile Type #1 (ACT-1): Armstrong #704A
2. Acoustical Ceiling Tile Type #2 (ACT-2): Armstrong #1775
3. Acoustical Ceiling Tile Type #3 (ACT-3): Armstrong #3254
4. Acoustical Ceiling Tile Type #4 (ACT-4): Gridstone ½” x 24” x 24” vinyl-covered gypsum board panel

2.3 ACCESSORIES

A. Hold Down Clips: Minimum 24 gage spring steel, manufacturer’s standard profile.
B. Touch-Up Paint: Color to match acoustical panels and suspension grid.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install ceilings in accordance with ASTM C636 and CISCA Handbook.
B. Minimize panels less than one half size.
C. Place acoustical panels with edges resting flat on suspension grid.
D. Cutting Acoustic Units:
   1. Cut to fit irregular grid and perimeter edge trim and around penetrations.
   2. Locate cuts to be concealed.
   3. Cut and field paint exposed edges of reveal edge units to match factory edge.
E. Place hold down clips over cross tees at mid point of each module.

3.2 ADJUSTING

A. Touch up minor scratches and abrasions to match factory finish.

END OF SECTION
SECTION 09 6513
RESILIENT BASE

GENERAL
1.1 SUMMARY
   A. Section Includes:
      1. Resilient wall base.
   B. Related Sections:
      1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES
   B. Resilient Floor Covering Institute (RFCI) - FloorScore Certification Program.

1.3 SUBMITTALS
   A. Submittals for Review:
      1. Samples: 4 inch long samples in each color.

1.4 MAINTENANCE
   A. Extra Materials: 5 percent of each profile and color.

PART 2 PRODUCTS
2.1 MANUFACTURERS
   A. Acceptable Manufacturers:
      1. Inpro. (www.inprocorp.com)
         Contact: Teri Jablonski
         tjablonski@inprocorp.com
         800-222-5556
   B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS
   A. Resilient Base:
      1. Type: ASTM F1861, thermoplastic vinyl.
      2. Thickness: 0.125 inch.
      3. Profile: Coved.
      4. Height: 4 inches.
      5. Length: 120 foot rolls.
      7. Finish: Matte.
      8. End units and outside corners: Preformed; profile, size, and color to match base.

2.3 ACCESSORIES
   A. Adhesive:
      1. Water based, waterproof, recommended by base manufacturer.

PART 3 EXECUTION

Resilient Base 096513-1
3.1 PREPARATION

A. Prepare surfaces to receive base:
   1. Remove materials that could interfere with adhesion.
   2. Fill low spots with patching compound; finish flush with adjacent surface.
   3. Remove high spots, ridges and nibs.

3.2 INSTALLATION

A. Apply adhesive continuously to back of base.

B. Maintain top edge true to line and bottom edge in continuous contact with floor. Butt joints tight; butt base tight to adjacent construction.

C. Do not install pieces less than 6 inches long.

D. Miter and butt inside corners.

E. At outside corners [install preformed corner pieces.

F. At exposed ends, install pre-molded units.

G. Scribe to door frames and other interruptions.

END OF SECTION
SECTION 09 6516

RESILIENT STRIP FLOORING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Resilient vinyl sheet flooring.
   2. Edgings and Cap strips.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):
   3. F710 - Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring.
   5. F1869 - Standard Test Method for Measuring Moisture Vapor Emission Rate of Concrete Subfloor Using Anhydrous Calcium Chloride.

B. Resilient Floor Covering Institute (RFCl) - FloorScore Certification Program.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Indicate room or space dimensions, flooring layout, and locations of seams.
   2. Product Data: Provide data on specified products, describing physical and performance characteristics.
   3. Samples:
      a. Flooring: 6 x 6 inch samples [in each color and pattern.
      b. Edgings: Cap strips:4 inch long samples in each color.

B. Quality Control Submittals:
   1. Certificates of Compliance: Certification from an independent testing laboratory that flooring meets fire hazard classification requirements.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 5 years [documented] experience in work of this Section.
B. Fire Hazard Classification: Class I rated, tested to ASTM E648.
C. Static Coefficient of Friction: Minimum 0.5, tested to ASTM D2047.

1.5 PROJECT CONDITIONS

A. Maintain temperature in spaces to receive flooring between 70 and 90 degrees F for 24 hours before, during, and for minimum 48 hours after installation.
B. Maintain minimum temperature of 55 degrees F after flooring is installed, except as otherwise specified.

1.6 MAINTENANCE

096516-1 Resilient Sheet Flooring
PART 2  PRODUCTS

2.1  MANUFACTURERS

A. Acceptable Manufacturers - Strip Vinyl Flooring:
   1. Tandus Centiva. (www.tandus-centiva.com)
      Contact: Jenn Hautamaki
      Jenn.Hautamaki@tarkett.com
      313-330-1629

B. Substitutions: Under provisions of Division 01.

2.2  MATERIALS

A. Strip Vinyl Flooring:
   1. Conform to ASTM F1913.
   2. Manufacturer: Tandus-Centiva.
   5. Width: 6” x 36”.
   6. Emboss: Rough (RG)

2.3  ACCESSORIES

A. Leveling Compound: White, premixed, latex based.

B. Adhesive:
   1. Water based, waterproof, recommended by flooring manufacturer.

C. Edgings: Preformed rubber, or approved substitute, profile required to suit conditions, color to be selected from manufacturer's full color range.

PART 3  EXECUTION

3.1  EXAMINATION

A. Verify that concrete floors have cured a minimum 28 days and do not exhibit negative alkalinity, carbonization, or dusting.

3.2  PREPARATION

A. Clean substrate; remove loose and foreign matter that could impede adhesion or performance of flooring.

B. Fill cracks, voids, and depressions in substrate with leveling compound.

C. Grind off high spots and projections in substrate; leave smooth and level to 1/4 inch in 10 feet.

D. Test substrate for moisture content to ASTM F1869; do not install flooring until moisture emission level is acceptable to flooring manufacturer.

3.3  INSTALLATION

A. Install flooring in accordance with manufacturer's instructions.

B. Lay out flooring to minimize seams, located as inconspicuously as possible.
C. Spread only enough adhesive to permit installation of materials before initial set.

D. Lay flooring with seams parallel to building lines.

E. Roll flooring with floor roller to eliminate entrapped air and ensure bond with adhesive. Work toward edges of sheets. Hand roll seams on both sides, working toward seams.

F. Scribe flooring to walls, columns, cabinets, and other appurtenances to produce tight joints. Ensure that base, trim, plates, or escutcheons will completely cover cut edges.

G. Extend flooring into recesses and under equipment.

H. Terminate flooring at centerline of door openings where adjacent floor finish is dissimilar.

3.4 INSTALLATION OF EDGINGS

A. Install strips where flooring abuts dissimilar flooring materials; secure to subfloor.

B. Center strips under doors where flooring terminates at door openings.

C. Install in longest practical lengths; butt ends tight.

D. Scribe to abutting surfaces.

3.5 PROTECTION

A. Do not allow traffic on flooring until adhesives have set. Cover areas subject to traffic with protective covering.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Tile carpeting.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

C. Allowances:
   1. Include a unit cost allowance of $3.50 per square foot for carpet tiles.
   2. Installation is not included in amount of allowance, and is to be included in Contract Sum.

1.2 REFERENCES

A. ASTM International (ASTM):
   2. D4258 - Standard Practice for Surface Cleaning Concrete for Coating.
   6. F710 - Standard Practice for Preparing Concrete to Receive Resilient Flooring.

B. Carpet and Rug Institute (CRI):
   2. Indoor Air Quality Testing Program.


1.3 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings: Indicate carpet tile locations, dye lot limitations, direction of carpet tile in each room or area, and type and location of edgings.
   2. Samples:
      a. Carpet tile: Full size samples in each color and pattern.
   3. Warranty: Sample warranty form.

B. Quality Control Submittals:
   1. Certificates of Compliance: Certification from an independent testing laboratory that carpet tiles meet fire hazard classification requirements.

1.4 QUALITY ASSURANCE

A. Fire Hazard Classification: Pass flammability requirements of ASTM D2859.
1.5 PROJECT CONDITIONS
   A. Do not begin installation until painting and finishing work have been completed.
   B. Environmental Requirements:
      1. Temperature of spaces and subfloor between 65 and 90 degrees F.
      2. Humidity in spaces to receive carpet tiles between 20 and 65 percent.

1.6 WARRANTIES
   A. Furnish manufacturer’s 10 year warranty providing coverage against:
      1. Defective materials and workmanship.
      2. Excessive fading.
      3. Loss of static control.
      4. Edge raveling.
      5. Runs.
      7. Loss of face fiber.
      8. Excessive wear.

1.7 MAINTENANCE
   A. Extra Materials: Two unopened cartons of each tile.

PART 2 PRODUCTS

2.1 MANUFACTURERS
   A. Acceptable Manufacturers - Carpet Tiles:
      1. Interface, Inc. (www.interfaceinc.com)
      2. Mohawk International (www.mohawkinternational.com)
   B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS
   A. Carpet Tiles: To be selected under an allowance.

2.3 ACCESSORIES
   A. Adhesive:
      1. Waterproof, latex based cement formulated specifically for installing carpet tiles; recommended by carpet tile manufacturer.
   B. Leveling Compound: Premixed, latex based.

PART 3 EXECUTION

3.1 EXAMINATION
   A. Verify that concrete floors have cured a minimum 28 days and do not exhibit negative alkalinity, carbonization, or dusting.

3.2 PREPARATION
   A. Clean substrate; remove loose and foreign matter that could impede adhesion or performance of flooring.
B. Fill cracks, voids, and depressions with leveling compound.

C. Grind ridges and high spots smooth.

D. Test Substrate:
   1. Moisture vapor: Test to ASTM F1869; do not install carpet tiles until moisture emission level is acceptable to carpet tile manufacturer.
   2. Humidity: Test to ASTM F2170; do not install carpet tiles until relative humidity is acceptable to carpet tile manufacturer.
   3. Alkalinity: Test to ASTM F710; do not install carpet tiles unless pH is acceptable to carpet tile manufacturer.

3.3 INSTALLATION OF CARPET TILES

A. Install in accordance with CRI 104.

B. Install carpet tile and adhesive in accordance with manufacturers' instructions.

C. Blend carpet tiles from different cartons to ensure minimal variation in color match.

D. Lay out each room or area to minimize tiles less than one half size.

E. Cut tile clean. Fit tiles tight to intersection with vertical surfaces without gaps.

F. Lay carpet tile to manufacturer's recommended pattern, with tile direction to next unit, set parallel to building lines.

G. Locate change of color or pattern between rooms under door centerline.

H. Fully adhere carpet tiles to substrate.

3.4 INSTALLATION OF EDGINGS

A. Install strips where carpet tiles abut dissimilar flooring materials; secure to subfloor.

B. Center strips under doors where carpet tiles terminate at door openings.

C. Install in longest practical lengths; butt ends tight.

D. Scribe to abutting surfaces.

3.5 CLEANING

A. Clean spots as recommended by carpet tile manufacturer.

B. Cut off loose threads flush with top surface.

C. Clean with commercial vacuum cleaner.

END OF SECTION
PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Surface preparation and field application of paints.

B. Related Sections:
   1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. ASTM International (ASTM):

B. Green Seal, Inc. (GS) 11 - Standard for Paints and Coatings.


D. Society for Protective Coatings (SSPC) - Painting Manual.

1.3 SUBMITTALS

A. Submittals for Review:
   1. Product Data: Manufacturer’s data on materials proposed for use including:
      a. Product designation and grade.
      b. Product analysis and performance characteristics.
      c. Standards compliance.
      d. Material content.
      e. Mixing and application procedures.
   2. Samples:
      a. [3 x 6] inch samples of each coating system on representative substrate. Step back successive coats so that all coats remain exposed. Indicate type of material used for each coat.
   3. Paint Schedule: Indicate types and locations of each surface, paint materials, and number of coats to be applied.

1.4 QUALITY ASSURANCE

A. Applicator Qualifications: Minimum 5 years experience in work of this Section.


C. Mockup:
   1. Construct mockup panels for interior wall finishes, 4 feet wide x 8 feet high
   2. Show: Each color and texture.
   3. Locate [where directed.
   4. Approved mockup may remain as part of the Work.

1.5 DELIVERY, STORAGE AND HANDLING
A. Container Labels: Include manufacturer’s name, type of paint, brand name, lot number, brand code, coverage rates, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.

B. Paint Materials: Store at ambient temperature from [45 to 90] degrees F in ventilated area, or as required by manufacturer's instructions.

1.6 PROJECT CONDITIONS

A. Do not apply materials when surface and ambient temperatures or relative humidity are outside ranges required by paint manufacturer.

B. Maintain ambient and substrate temperatures above manufacturer's minimum requirements for 24 hours before, during, and after paint application.

C. Do not apply materials when relative humidity is above 85 percent or when dew point is less than 5 degrees F different than ambient or surface temperature.


1.7 MAINTENANCE

A. Extra Materials: [1 gallon] of each color and sheen.

PART 2  PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Benjamin Moore and Co. (www.benjaminmoore.com)
   2. DeVoe Paint Co. (www.devoepaint.com)
   5. PPG Architectural Finishes, Inc. (www.pittsburghpaints.com)
   7. Sherwin Williams. (www.sherwin-williams.com)

B. Substitutions: [Under provisions of Division 01.

2.2 MATERIALS

A. Paints:
   1. As scheduled at end of Section, or approved substitute.
   2. Free from all forms of lead and mercury.

B. Maximum Volatile Organic Compound (VOC) Content for interior paints, coatings, and accessories, tested to ASTM D6886:
   1. Primers: [100] grams per liter.
   2. Flat paints and coatings: [50] grams per liter.
   3. Non-flat paints and coatings: [50] grams per liter.
   4. Rust preventative coatings: [100] grams per liter.
   7. Dryfall coatings: [150] grams per liter.

C. Gloss Ratings:
<table>
<thead>
<tr>
<th>Gloss Designation</th>
<th>Units at 60 Degrees</th>
<th>Units at 85 Degrees</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flat</td>
<td>0 to 5</td>
<td>Maximum 10</td>
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<tr>
<td>Eggshell</td>
<td>10 to 25</td>
<td>10 to 35</td>
</tr>
<tr>
<td>Satin</td>
<td>20 to 35</td>
<td>Minimum 35</td>
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<tr>
<td>Semigloss</td>
<td>35 to 70</td>
<td></td>
</tr>
<tr>
<td>Gloss</td>
<td>70 to 85</td>
<td></td>
</tr>
<tr>
<td>High Gloss</td>
<td>Minimum 85</td>
<td></td>
</tr>
</tbody>
</table>

2.3 ACCESSORIES
   A. Accessory Materials: Paint thinners and other materials required to achieve specified finishes; commercial quality.
   B. Patching Materials: Latex filler.
   C. Fastener Head Cover Materials: Latex filler.

2.4 MIXES
   A. Deliver paints pre-mixed and pre-tinted.
   B. Uniformly mix to thoroughly disperse pigments.
   C. Do not thin in excess of manufacturer’s recommendations.
   D. Re-mix paint during application; ensure complete dispersion of settled pigment and uniformity of color and gloss.

PART 3 EXECUTION

3.1 EXAMINATION
   A. Test shop applied primer for compatibility with subsequent coatings.
   B. Measure moisture content of surfaces using electronic moisture meter. Do not apply coatings unless moisture content of surfaces are below following maximums:
      1. [Gypsum board] [and] [plaster]: [12] __ percent.
      2. [Masonry] [and] [concrete]: [12] __ percent.

3.2 PREPARATION
   A. General:
      1. Protect adjacent and underlying surfaces.
      2. Remove [or mask] electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.
      3. Correct defects and clean surfaces capable of affecting work of this section.
      4. Seal marks that may bleed through surface finishes with waterborne stain blocker.
   B. Impervious Surfaces: Remove mildew by scrubbing with solution of trisodium phosphate and bleach. Rinse with clean water and allow to dry.
C. Gypsum Board:
   1. Fill minor defects with filler compound. Spot prime defects after repair.

D. Concrete Floors:
   1. Remove contamination, acid etch, and rinse floors with clear water. Allow to dry.
   2. Verify that required acid-alkali balance has been achieved.

E. Existing Surfaces:
   1. Remove loose, flaking, powdery, and peeling paints.
   2. Lightly sand glossy painted surfaces.
   3. Fill holes, cracks, depressions and other imperfections with patching compound; sand flush with surface.
   4. Remove oil, grease, and wax by scraping; solvent wash and thoroughly rinse.
   5. Remove rust by wire brushing to expose base metal.

3.3 APPLICATION

A. Apply paints in accordance with [manufacturer’s instructions] [and] [MPI Painting Manual, [Premium] [Custom] Grade finish requirements].

B. Apply primer or first coat closely following surface preparation to prevent recontamination.

C. Do not apply finishes to surfaces that are not dry.

D. Apply coatings to minimum dry film thickness recommended by manufacturer.

E. Apply each coat of paint slightly darker than preceding coat unless specified otherwise.

F. Apply coatings to uniform appearance without laps, sags, curtains, holidays, and brush marks.

G. Allow applied coats to dry before next coat is applied.

H. When required on deep and bright colors apply an additional finish coat to ensure color consistency.

I. Continue paint finishes behind wall-mounted accessories.

J. Sand between coats on interior [wood] [and] [metal] surfaces.

K. Match final coat to approved color samples.

L. Where clear finishes are specified, tint fillers to match wood. Work fillers into grain before set. Wipe excess from surface.

M. Prime concealed surfaces of [exterior wood] [and] [interior wood in contact with masonry or cementitious materials] with one coat primer paint.

N. Mechanical and Electrical Components:
   1. Paint factory primed equipment.
   2. Remove unfinished and primed louvers, grilles, covers, and access panels; paint separately.
   3. Paint exposed and insulated pipes, conduit, boxes, ducts, hangers, brackets, collars, and supports unless factory finished.
   4. Do not paint name tags or identifying markings.
   5. Paint exposed conduit and electrical equipment in finished areas.
   6. Paint duct work behind louvers, grilles, and diffusers flat black to minimum of 18 inches or beyond sight line.

O. Do not Paint:
   1. Surfaces indicated on Drawings or specified to be unpainted or unfinished.
2. Surfaces with factory applied finish coat or integral finish.
3. Architectural metals, including brass, bronze, stainless steel, and chrome plating.

3.4 ADJUSTING
   A. Touch up or refinish disfigured surfaces.

3.5 CLEANING
   A. Remove paint from adjacent surfaces.

3.6 PAINT SCHEDULE
   A. Types of paint listed herein are set forth as standard of quality and type of coating required for each type of surface.
      1. Paint exposed surfaces of types listed in Paint Schedule.
      2. Paint other exposed surfaces not specifically listed with not less than two coats of appropriate type of coating.

   B. Prime coat consists of touch up on shop primed and existing surfaces with intact coatings.

END OF SECTION
SECTION 10 4413
FIRE EXTINGUISHERS AND CABINETS

PART 1 GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Portable fire extinguishers.
      2. Cabinets
   B. Related Sections:
      1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES
   B. National Fire Protection Association (NFPA) 10 - Portable Fire Extinguishers.
   C. Underwriters Laboratories (UL):
      1. 154 - Carbon Dioxide Fire Extinguishers.
      2. 299 - Dry Chemical Fire Extinguishers.
      3. 626 - 2-1/2 Gallon Stored Pressure, Water Type Fire Extinguishers.
      5. 2129 - Halocarbon Clean Agent Fire Extinguishers.

1.3 SUBMITTALS
   A. Submittals for Review:
      1. Shop Drawings: Indicate cabinet locations and mounting heights.
      2. Product Data: Include data on extinguishers and cabinets, cabinet dimensions, operational features, materials, finishes, and anchorage.
   B. Closeout Submittals:
      1. Maintenance Data: Include test, refill, or recharge schedules and re-certification requirements.

1.4 QUALITY ASSURANCE
   A. Provide fire extinguishers complying with UL 711 and applicable code.
   B. Cabinets in Fire Rated Partitions: Tested in accordance with ASTM E814 with fire resistance rating equivalent to adjacent construction.
   C. Conform to applicable accessibility code for locating extinguishers.

1.5 PROJECT CONDITIONS
   A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS
   A. Acceptable Manufacturers:
B. Substitutions: Under provisions of Division 01.

2.2 COMPONENTS

A. Extinguishers:
   1. Multi-purpose dry chemical type, UL 299, cast steel tank, Class 2A:10B:C, 10 pound nominal capacity.

B. Cabinets:
   1. Formed stainless steel sheet, 18 gage minimum.
   2. Configuration: Semi-recessed, sized to accommodate extinguishers.
   3. Trim: Returned to wall surface.
   4. Door:
      a. Solid style, equipped with keyed lock with emergency release or pull to break glass feature. Key locks alike; furnish six keys.
      b. Hinge doors for 180 degree opening with continuous piano hinge.

2.3 ACCESSORIES

A. Mounting Hardware: Type best suited to application.

2.4 FINISHES

A. Cabinet:
   1. Exterior and door: No. 4 satin
   2. Interior:

B. Cabinet: No. 4 satin.

C. Extinguishers: Baked enamel, red color.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install cabinets in accordance with manufacturer's instructions.

B. Set plumb, level, and rigid.

C. Place an extinguisher in each cabinet.

END OF SECTION
PART 1

GENERAL

1.1 SUMMARY

A. Section Includes:
1. Pre-engineered, shop fabricated structural steel building frame.
2. Metal wall and roof panel system including trim and accessories.
3. Thermal insulation.
4. Skylights.
5. Gutters and downspouts.

B. Related Sections:
1. Division 01: Administrative, procedural, and temporary work requirements.

1.2 REFERENCES

A. American Architectural Manufacturers Association (AAMA)www.aamanet.org:
1. 621 - Voluntary Specifications for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates.


C. American Iron and Steel Institute (AISI)www.steel.org - Specifications for Cold-Formed Members.

D. American Society of Civil Engineers (ASCE)www.asce.org 7 - Minimum Design Loads for Buildings and Other Structures.


F. Florida Building Code Sixth Edition (2017) Table 1604.3 (Deflection Limits)

G. ASTM International (ASTM)www.astm.org:
5. A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
H. Metal Building Manufacturers Association (MBMA)www.mbma.com:


1.3 SYSTEM DESCRIPTION

A. Pre-Engineered Metal Building System:
   1. Clear span rigid frame.
   2. Primary framing: Rigid frame of rafter beams and columns, lean-to frames, braced end frames, end wall columns, and wind bracing.
   3. Secondary framing: Purlins, girts, eave struts, clips, and other items indicated or required.
   4. Wall and roof panels: Preformed, prefinished metal panels with subgirt framing, insulation, and liner panels.

B. Design Requirements:
   1. Design framing and panels in accordance with MBMA Manual.
   2. Design structural steel members and light gage steel framing in accordance with AISC Specifications.
   3. Total load deflection: Roof L/180; Walls L/240
   4. Welded connections: In accordance with AWS D1.1/D1.1M.
   5. Anchor bolts: Design anchor bolts to resist horizontal and uplift reactions at column bases.
   7. Thermal expansion and contraction: Withstand movement caused by an ambient temperature range of 120 degrees F and a surface temperature range of 160 degrees F.

C. Design Loads: Design system to withstand:
   1. Live and dead loads in accordance with Florida Building Code.
   2. Design wind pressure in accordance with ASCE 7, Florida Building Code, with maximum allowable deflection of L/180.
   3. Weight of additional imposed loads of mechanical and electrical systems, ceiling, roofing, and other elements.
   4. Special loads: Concentrated loads as indicated.
   5. Limit deflection of framing members supporting exterior glazed assemblies to L/360.
   6. Primary frame lateral drift:
      a. Base wind pressures for purposes of calculating lateral drift of primary frames on 50 year mean recurrence interval using scheduled wind speed.
      b. Limit deflection of framing members to H/100.

1.4 SUBMITTALS

A. Submittals for Review:
   1. Shop Drawings:
      a. Include for structural components:
         1) Plans, elevations, and sections showing location of components.
         2) Details showing anchoring, fastening, and interface with other work.
      b. Include for panels:
         1) Configuration of panels, trim members, and closures.
         2) Assembly of system components, including typical and special conditions.
   2. Product Data: Include description of system components and verify compliance with specified requirements.
   3. Samples:
      a. 3 x 3 inch coating samples showing available colors.
      b. After color selection Submit 12 inch long panel samples in proposed profile.

1.5 QUALITY ASSURANCE
A. Designer Qualifications: Professional Structural Engineer licensed in state in which project is located, with minimum 5 years experience in work of this Section.

B. Installer Qualifications: Minimum 10 years experience in work of this Section.

C. Welder Qualifications: AWS D1.1/D1.1M.

D. Size gutters and downspouts for rainfall intensity determined by a storm occurrence of one in 50 years.

1.6 DELIVERY, STORAGE AND HANDLING

A. Store steel above ground on platforms, skids, or other supports; separate with wooden separators.

B. Protect steel from corrosion.

C. Prevent damage to prime coat; use wooden protectors to prevent damage from chain or cable cinches.

D. Protect panels and trim from contact with materials that could cause staining or discoloration of finish.

1.7 WARRANTIES

A. Furnish manufacturer’s 20 year warranty providing coverage against flaking, chipping, cracking, fading, or delamination of panel finish.

B. Furnish manufacturer’s 20 year warranty providing coverage against rupture, perforation, or structural failure of aluminum-zinc alloy coated panels.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   5. Mid-West Steel Building Company. (www.mid-weststeel.com)

B. Substitutions: Under provisions of Division 01.

2.2 MATERIALS

A. Framing:
   1. Primary components: ASTM A572/A572M, Grade 50.
   2. Secondary components: ASTM A1008/A1008M.
   3. Fasteners:
      a. Primary framing: ASTM A325.

B. Metal Wall and Roof Panels, Gutters, Downspouts, Trim, and Closures: ASTM A792/A792M aluminum-zinc alloy coated steel, Commercial Quality

C. Panel Closures: Die cut compressible filler to fit panel configuration.
D. Fasteners: Stainless or plated steel, type as required; head color to match panels where exposed, with nylon or neoprene washers.

E. Skylights: Manufacturer's standard.

F. Insulation: ASTM C665, white poly/scrim faced fiberglass blankets, 3 inches thick, maximum flame spread/smoke developed rating of 25/50 where exposed.

2.3 FABRICATION

A. Steel Framing Components:
   1. Fabricate structural steel in accordance with AISC and AISI Specifications.
   2. Welding: AWS D1.1/D1.1M.

B. Wall Panels:
   1. Precoated Aluminum-zinc alloy coated steel sheet, minimum 24 gauge core steel, roll formed.
   2. 36 inches wide x 1-1/2 inches high, major corrugations at 12 inches on center and minor corrugations at 4 inches on center, interlocking edges.
   3. Single piece from base to top of wall.
   4. Trim members: Form from same material and gage and with same finish as panels.

C. Roof Panels:
   1. Precoated Aluminum-zinc alloy coated steel sheet, minimum 24 gauge core steel, roll formed.
   2. Standing seam type, manufacturer's standard configuration.
   3. 36 inches wide x 1-1/2 inches high, major corrugations at 12 inches on center and minor corrugations at 4 inches on center, interlocking edges.
   4. Ridge assembly designed to allow thermal movement.
   5. Factory punched at ends to match holes in eave member.
   6. Designed to fasten to supports by means of thermally responsive panel clips.
   7. Single piece from ridge to eave.
   8. Trim members: Form from same material and gage and with same finish as panels.

D. Gutters and Downspouts:
   1. Precoated Aluminum-zinc alloy steel sheet, minimum 26 gauge core steel, roll formed.
   2. Fabricate end caps, downspout outlets and headers, straps, brackets, and downspout strainers in profile to suit gutters and downspouts.

2.4 FINISHES

A. Framing Members: Shop paint steel surfaces except surfaces to be welded and contact surfaces of high strength friction type bolted connections.
   1. Surface preparation: SSPC SP2 - Hand Tool Cleaning or SP3 - Power Tool Cleaning.
   2. Application: One coat; follow coating manufacturer's instructions.

B. Panels and Trim: AAMA 2605, fluoropolymer coating containing minimum 70 percent PVDF resins, color to be selected from manufacturer's full color range.

PART 3 EXECUTION

3.1 ERECTION OF FRAMING SYSTEM

A. Install in accordance with AISC and AISI Specifications, manufacturer's instructions, and approved Shop Drawings.

B. Fit members square against abutting components.

C. Position members plumb, square, and level.
D. Temporarily brace members until permanently fastened.
E. Do not splice load bearing members.
F. Align and adjust various members forming parts of a complete frame or structure after assembly but before fastening.
G. Rigidly connect members using welds or bolts.
H. Installation Tolerances:
   1. Maximum variation from location: Plus or minus 1/4 inch.
   2. Maximum variation from plane: 1/4 inch in 10 feet.

3.2 INSTALLATION OF METAL PANELS
A. Install in accordance with manufacturer's instructions and approved Shop Drawings.
B. Install aligned, level, and plumb.
C. Install panels in continuous lengths from ridge to eave and from base to top of wall. Lap end joints 4 inches minimum. Locate panel joints over supports.
D. Lap end joints 4 inches minimum.
E. Install trim to maintain visual continuity of system.
F. Install joint sealers and gaskets to prevent water penetration.
G. Flash penetrations through roofing with metal trim to match panels:
   1. Lap flashings over roof panels 12 inches minimum on all sides and seal with double bead of joint sealer.
   2. Install metal draw band and joint sealer at top of pipe penetrations.
   3. Install water diverter at uphill side of square and rectangular penetrations.

3.3 INSTALLATION OF GUTTERS AND DOWNSPOUTS
A. Gutters: Secure with straps spaced maximum 36 inches on center and within 6 inches of ends.
B. Downspouts:
   1. Secure with straps spaced maximum 8 feet on center and within 2 feet of ends and elbows.
   2. Flash downspouts minimum 3 inches into gutters and fasten.
   3. Flash upper sections into lower sections minimum 2 inches at joints; fasten sections together.

3.4 ADJUSTING
A. After erection of structural steel, touch up bolt heads and nuts, field welds, and abrasions with same primer used in shop.
B. Touch up field cuts, scratches, and abrasions on exposed panel surfaces and trim to match factory finish.

END OF SECTION
1 GENERAL

1.1 The work covered by this division consists of providing all labor, equipment and materials and performing all operations necessary for the installation of the plumbing work as herein called for and shown on the drawings.

1.2 Related Documents:

1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2.2 This is a Basic Plumbing Requirements Section. Provisions of this section apply to work of all Division 22 sections.

1.2.3 Provisions of all Division-23 Basic Mechanical Requirements Sections apply to work of all Division 22 sections.

1.2.4 Review all other contract documents to be aware of conditions affecting work herein.

1.2.5 Definitions:

1.2.5.1 Provide: Furnish and install, complete and ready for intended use.

1.2.5.2 Furnish: Supply and deliver to project site, ready for subsequent requirements.

1.2.5.3 Install: Operations at project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar requirements.

1.3 Permits and Fees: Contractor shall obtain all necessary permits, meters, and inspections required for his work and pay all fees and charges incidental thereto.

1.4 Verification of Owner's Data: Prior to commencing any work the Contractor shall satisfy himself as to the accuracy of all data as indicated in these plans and specifications and/or as provided by the Owner. Should the Contractor discover any inaccuracies, errors, or omissions in the data, he shall immediately notify the Architect/Engineer in order that proper adjustments can be anticipated and ordered. Commencement by the Contractor of any work shall be held as an acceptance of the data by him after which time the Contractor has no claim against the Owner resulting from alleged errors, omissions or inaccuracies of the said data.

1.5 Delivery and Storage of Materials: Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. All material shall be stored to provide protection from the weather and accidental damage.

1.6 Extent of work is indicated by the drawings, schedules, and the requirements of the specifications. Singular references shall not be constructed as requiring only one device if multiple devices are shown on the drawings or are required for proper system operation.

1.7 Field Measurements and Coordination:

1.7.1 The intent of the drawings and specifications is to obtain a complete and satisfactory installation. Separate divisional drawings and specifications shall not relieve the Contractor or subcontractors from full compliance of work of his trade indicated on any of the drawings or in any section of the specifications.
1.7.2 Verify all field dimensions and locations of equipment to insure close, neat fit with other trades' work. Make use of all contract documents and approved shop drawings to verify exact dimension and locations.

1.7.3 Coordinate work in this division with all other trades in proper sequence to insure that the total work is completed within contract time schedule and with a minimum cutting and patching.

1.7.4 Locate all apparatus symmetrical with architectural elements. Install to exact height and locations when shown on architectural drawings. When locations are shown only on plumbing drawings, be guided by architectural details and conditions existing at job and correlate this work with that of others.

1.7.5 Install work as required to fit structure, avoid obstructions, and retain clearance, headroom, openings and passageways. Cut no structural members without written approval.

1.7.6 Carefully examine any existing conditions, piping, and premises. Compare drawings with existing conditions. Report any observed discrepancies. It shall be the Contractor's responsibility to properly coordinate the work and to identify problems in a timely manner. Written instructions will be issued to resolve discrepancies.

1.7.7 Because of the small scale of the drawings, it is not possible to indicate all offsets and fittings or to locate every accessory. Drawings are essentially diagrammatic. Study carefully the sizes and locations of structural members, wall and partition locations, trusses, and room dimensions and take actual measurements on the job. Locate piping, ductwork, equipment and accessories with sufficient space for installing and servicing. Contractor is responsible for accuracy of his measurements and for coordination with all trades. Contractor shall not order materials or perform work without such verification. No extra compensation will be allowed because field measurements vary from the dimensions on the drawings. If field measurements show that equipment or piping cannot be fitted, the Architect/Engineer shall be consulted. Remove and relocate, without additional compensation, any item that is installed and is later found to encroach on space assigned to another use.

1.8 Guarantee:

1.8.1 The Contractor shall guarantee labor, materials and equipment for a period of one (1) year from Final Completion, or from Owner's occupancy, whichever is earlier. Contractor shall make good any defects and shall include all necessary adjustments to and replacement of defective items without expense to the Owner.

1.8.2 Owner reserves right to make emergency repairs as required to keep equipment in operation without voiding Contractor's Guarantee Bond nor relieving Contractor of his responsibilities during guarantee period.

1.9 Approval Submittals:

1.9.1 When approved, the submittal control log and submittals shall be an addition to the specifications herewith, and shall be of equal force in that no deviation will be permitted except with the approval of the Architect/Engineer.

1.9.1.1 Shop drawings, product literature, and other approval submittals will only be reviewed if they are submitted in full accordance with the General and Supplementary Conditions and Division 1 Specification sections and the following.

1.9.1.1.1 Submittals shall be properly organized in accordance with the approved submittal control log.

1.9.1.1.2 Submittals shall not include items from more than one specification section in the same submittal package unless approved in the submittal control log.

1.9.1.1.3 Submittals shall be properly identified by a cover sheet showing the project name, Architect and Engineer names, submittal control number, specification section, a list of products or item names with model numbers in the order they appear in the package, and spaces for approval stamps. A sample cover sheet is included at the end of this section.
1.9.1.1.4 Submittals shall have been reviewed and approved by the General Contractor (or Prime Contractor). Evidence of this review and approval shall be an “Approved” stamp with a signature and date on the cover sheet.

1.9.1.1.5 Submittals that include a series of fixtures or devices (such as plumbing fixtures or valves) shall be organized by the fixture number or valve type and be marked accordingly. Each fixture must include all items associated with that fixture regardless of whether or not those items are used on other fixtures.

1.9.1.1.6 The electrical design shown on the drawings supports the plumbing equipment basis of design specifications at the time of design. If plumbing equipment is submitted with different electrical requirements, it is the responsibility of the plumbing contractor to resolve all required electrical design changes (wire and conduit size, type of disconnect or overload protection, point(s) of connection, etc.) and clearly show the new electrical design on the plumbing submittal with a written statement that this change will be provided at no additional cost. Plumbing submittals made with no written reference to the electrical design will be presumed to work with the electrical design. Any corrections required will be at no additional cost.

1.9.2 If the shop drawings show variation from the requirements of contract because of standard shop practice or other reasons, the Contractor shall make specific mention of such variation in writing in his letter of transmittal and on the submittal cover sheet in order that, if acceptable, Contractor will not be relieved of the responsibility for executing the work in accordance with the contract.

1.9.3 Review of shop drawings, product literature, catalog data, or schedules shall not relieve the Contractor from responsibility for deviations from contract drawings or specifications, unless he has in writing called to the attention of the Architect/Engineer each such deviation in writing at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings, product literature, catalog data, or schedules. Any feature or function specified but not mentioned in the submittal shall be assumed to be included per the specification.

1.9.4 Submit shop drawings as called for in other sections after award of the contract and before any material is ordered or fabricated. Shop drawings shall consist of plans, sections, elevations and details to scale (not smaller than ¼" per foot), with dimensions clearly showing the installation. Direct copies of small scale project drawings issued to the Contractor are not acceptable. Drawings shall take into account equipment furnished under other sections and shall show space allotted for it. Include construction details and materials.

1.10 Test Reports and Verification Submittals: Submit test reports, certifications and verification letters as called for in other sections. Contractor shall coordinate the required testing and documentation of system performance such that sufficient time exists to prepare the reports, submit the reports, review the reports and take corrective action within the scheduled contract time.

1.11 O&M Data Submittals: Submit Operation and Maintenance data as called for in other sections. When a copy of approval submittals is included in the O&M Manual, only the final “Approved” or “Approved as Noted” copy shall be used. Contractor shall organize these data in the O&M Manuals tabbed by specification number. Prepare O&M Manuals as required by Division 1 and as described herein. Submit manuals at the Substantial Completion inspection.

2 PRODUCTS

2.1 All materials shall be new or Owner-supplied reused as shown on the drawings, the best of their respective kinds, suitable for the conditions and duties imposed on them at the building and shall be of reputable manufacturers. The description, characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the following sections.

2.2 Equipment and Materials:

2.2.1 Shall be new and the most suitable grade for the purpose intended. Equipment furnished under this division shall be the product of a manufacturer regularly engaged in the manufacture of such items for
a period of three years. Where practical, all of the components shall be products of a single manufacturer in order to provide proper coordination and responsibility. Where required, Contractor shall furnish proof of installation of similar units or equipment.

2.2.2 Each item of equipment shall bear a name plate showing the manufacturer's name, trade name, model number, serial number, ratings and other information necessary to fully identify it. This plate shall be permanently mounted in a prominent location and shall not be concealed, insulated or painted.

2.2.3 The label of the approving agency, such as UL, IBR, ASME, ARI, AMCA, by which a standard has been established for the particular item shall be in full view.

2.2.4 The equipment shall be essentially the standard product of a manufacturer regularly engaged in the production of such equipment and shall be a product of the manufacturer's latest design.

2.2.5 A service organization with personnel and spare parts shall be available within two hours for each type of equipment furnished.

2.2.6 Install in accordance with manufacturer's recommendations. Place in service by a factory trained representative where required.

2.2.7 Materials and equipment are specified herein by a single or by multiple manufacturers to indicate quality, material and type of construction desired. Manufacturer's products shown on the drawings have been used as basis for design; it shall be the Contractor's responsibility to ascertain that alternate manufacturer's products, or the particular products of named manufacturers, meet the detailed specifications and that size and arrangement of equipment are suitable for installation.

2.2.8 Model Numbers: Catalog numbers and model numbers indicated in the drawings and specifications are used as a guide in the selection of the equipment and are only listed for the contractor's convenience. The contractor shall determine the actual model numbers for ordering materials in accordance with the written description of each item and with the intent of the drawings and specifications.

2.2.9 All equipment and material shall be manufactured and assembled in the United States.

2.3 Requests for Substitution:

2.3.1 Where a particular system, product or material is specified by name, consider it as standard basis for bidding, and base proposal on the particular system, product or material specified.

2.3.2 Requests by Contractor for substitution will be considered only when reasonable, timely, fully documented, and qualifying under one or more of the following circumstances.

2.3.2.1 Required product cannot be supplied in time for compliance with Contract time requirements.

2.3.2.2 Required product is not acceptable to governing authority, or determined to be non-compatible, or cannot be properly coordinated, warranted or insured, or has other recognized disability as certified by Contractor.

2.3.2.3 Substantial cost advantage is offered Owner after deducting offsetting disadvantages including delays, additional compensation for redesign, investigation, evaluation and other necessary services and similar considerations.

2.3.3 All requests for substitution shall contain a "Comparison Schedule" and clearly and specifically indicate any and all differences or omissions between the product specified as the basis of design and the product proposed for substitution. Differences shall include but shall not be limited to data as follows for both the specified and substituted products:

Principal of operation.
Materials of construction or finishes.
Thickness of gauge of materials.
3 EXECUTION

3.1 Workmanship: All materials and equipment shall be installed and completed in a first-class workmanlike manner and in accordance with the best modern methods and practice. Any materials installed which do not present an orderly and reasonably neat and/or workmanlike appearance, or do not allow adequate space for maintenance, shall be removed and replaced when so directed by the Architect/Engineer.

3.2 Coordination:

3.2.1 The Contractor shall be responsible for full coordination of the plumbing systems with shop drawings of the building construction so the proper openings and sleeves or supports are provided for piping, ductwork, or other equipment passing through slabs or walls.

3.2.2 Any additional steel supports required for the installation of any plumbing equipment, piping, or ductwork shall be furnished and installed under the section of the specifications requiring the additional supports.

3.2.3 It shall be the Contractor's responsibility to see that all equipment such as valves, dampers, filters and such other apparatus or equipment that may require maintenance and operation are made easily accessible, regardless of the diagrammatic location shown on the drawings.

3.2.4 All connections to fixtures and equipment shown on the drawings shall be considered diagrammatic unless otherwise indicated by detail. The actual connections shall be made to fully suit the requirements of each case and adequately provide for expansion and servicing.

3.2.5 The contractor shall protect equipment, material, and fixtures at all times. He shall replace all equipment, material, and fixtures which are damaged as a result of inadequate protection.

3.2.6 Prior to starting and during progress of work, examine work and materials installed by others as they apply to work in this division. Report conditions which will prevent satisfactory installation.

3.2.7 Start of work will be construed as acceptance of suitability of work of others.

3.3 Interruption of Service: Before any equipment is shut down for disconnecting or tie-ins, arrangements shall be made with the Architect/Engineer and this work shall be done at the time best suited to the Owner. This will typically be on weekends and/or holidays and/or after normal working hours. Services shall be restored the same day unless prior arrangements are made. All overtime or premium costs associated with this work shall be included in the base bid.

3.4 Phasing: Provide all required temporary valves, piping, ductwork, equipment and devices as required. Maintain temporary services to areas as required. Remove all temporary material and equipment on completion of work unless Engineer concurs that such material and equipment would be beneficial to the Owner on a permanent basis.

3.5 Cutting and Patching: Notify General Contractor to do all cutting and patching of all holes, chases, sleeves, and other openings required for installation of equipment furnished and installed under this section. Utilize experienced trades for cutting and patching. Obtain permission from Architect/Engineer before cutting any structural items.
3.6 **Equipment Setting:** Bolt equipment directly to concrete pads or vibration isolators as required, using hot-dipped galvanized anchor bolts, nuts and washers. Level equipment.

3.7 **Painting:** Touch-up factory finishes on equipment located inside and outside shall be done under Division 22. Obtain matched color coatings from the manufacturer and apply as directed. If corrosion is found during inspection on the surface of any equipment, clean, prime, and paint, as required.

3.8 **Clean-up:** Thoroughly clean all exposed parts of apparatus and equipment of cement, plaster, and other materials and remove all oil and grease spots. Repaint or touch up as required to look like new. During progress of work, contractor is to carefully clean up and leave premises and all portions of building free from debris and in a clean and safe condition.

3.9 **Start-up and Operational Test:** Start each item of equipment in strict accordance with the manufacturer's instructions; or where noted under equipment specification, start-up shall be done by a qualified representative of the manufacturer. Alignment, lubrication, safety, and operating control shall be included in start-up check.

3.10 **Record Drawings:**

3.10.1 During the progress of the work the Contractor shall record on their field set of drawings the exact location, as installed, of all piping, ductwork, equipment, and other systems which are not installed exactly as shown on the contract drawings.

3.10.2 Upon completion of the work, record drawings shall be prepared as described in the General Conditions, Supplementary Conditions, and Division 1 sections.

3.11 **Acceptance:**

3.11.1 **Punch List:** Submit written confirmation that all punch lists have been checked and the required work completed.

3.11.2 **Instructions:** At completion of the work, provide a competent and experienced person who is thoroughly familiar with project, for one day to instruct permanent operating personnel in operation of equipment and control systems. This is in addition to any specific equipment operation and maintenance training.

3.11.3 **Operation and Maintenance Manuals:** Furnish four complete manuals bound in ring binders with Table of Contents, organized, and tabbed by specification section. Manuals shall contain:

- Detailed operating instructions and instructions for making minor adjustments.
- Complete wiring and control diagrams.
- Routine maintenance operations.
- Manufacturer's catalog data, service instructions, and parts lists for each piece of operating equipment.
- Copies of approved submittals.
- Copies of all manufacturer's warranties.
- Copies of test reports and verification submittals.

3.11.4 **Record Drawings:** Submit record drawings.

3.11.5 **Control Diagrams:** Frame under glass and mount on equipment room wall.

**END OF SECTION 22 01 00**
SECTION 22 05 63
EXCAVATION & BACKFILL

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 This section is a Division-22 Basic Plumbing Materials and Methods section, and is part of each Division-22 section making reference to or requiring excavation and backfill specified herein.

1.3 Existing Utilities: Underground utilities shown were taken from old drawings. The exact location of these utilities and irrigation branches and abandoned services are not known. Use extreme caution when excavating.

1.4 Refer to other Division-22 sections and/or drawings for specific requirements of the particular piping system being installed. Where another Division-22 section or the drawings conflict with requirements of this section, the other Division-22 section or the drawings shall take precedence over the general requirements herein.

1.5 OSHA: Contractor employee worker protection for all trenching and excavation operations shall comply with 29 CFR 1926.650 Subpart P and all current OSHA requirements.

1.6 Trench Safety Act: Contractor shall comply with all requirements of Florida Statutes Chapter 553, including the requirement to provide a separate line item to identify the cost to comply on a per lineal foot of trench and per square foot of shoring.

2 PRODUCTS

2.1 Sand: Clean, hard, uncoated grains free from organic matter or other deleterious substances. Sand for backfill shall be of a grade equal to mortar sand.

2.2 Gravel: Clean, well graded hard stone or gravel, free from organic material. Size range to be from No. 4 screen retentions to 1”.

2.3 Earth: Fill free of clay, muck, stones, wood, roots or rubbish.

2.4 Identification Tape: Polyethylene 6 inches wide, 0.004 inches thick, continuously printed with “CAUTION” in large letters and type of pipe below.

2.5 Copper Identification Wire: 14-gauge.

3 EXECUTION

3.1 Ditching and Excavation: Shall be performed by hand wherever there is a possibility of encountering obstacles or any existing utility lines of any nature whatsoever. Where clear and unobstructed areas are to be excavated, appropriate machine excavation methods may be employed. Avoid use of machine excavators within the limits of the building lines.

3.2 Bedding: Excavate to bottom grade of pipe to be installed, and shape bed of undisturbed earth to contour of pipe for a width of at least 50% of pipe diameter. If earth conditions necessitate excavation below grade of the pipe, such as due to the presence of clay, muck, or roots, subcut and bring bed up to proper elevation with clean, new sand (as described in paragraph 2.1), deposited in 6” layers and tamped. Notify Architect/Engineer if subcut exceeds 12”, or if bed is of an unstable nature. In this case a 6” minimum layer of gravel will be required before sand bedding begins. Submit cost proposal if the earth conditions require subcut in excess of 12” or if gravel is required to achieve proper bedding.

3.3 Placing: Pipe shall be carefully handled into place. Avoid knocking loose soil from the banks of the trench into the pipe bed. Rig heavier sections with nylon slings in lieu of wire rope to avoid crushing or
chipping. Pipe which is handled with insulation in place, coated pipe, and jacketed pipe shall have special handling slings as required to prevent damage to the material.

3.4 **Backfilling:** Deposit clean new sand (as described in paragraph 2.1) to 6" above the pipe and tamp. Then deposit sand or earth carefully in 6" layers, maintaining adequate side support, especially on nonferrous piping materials. Compact fill in 6" layers, using mechanical means, up to the top elevation of the pipe, and in 12" layers to rough or finish grade as required. Fine grade and restore surface to original condition.

3.5 **Special:** Excavations shall be installed and maintained in satisfactory condition during the progress of the work. Subsurface structures are to be constructed in adequately sized excavations. De-watering equipment shall be installed and properly maintained where required. Shoring shall be employed in the event of unstable soil condition, and in all cases where required by OSHA regulations and necessary to protect materials and personnel from injury.

3.6 **Identification:** Install identification tape directly above all underground piping, one tape for each pipe where multiple pipes are installed. Depth of tape shall be at least 6 inches below finished grade and 24" above buried pipe. Install copper wire above non-metallic pipes.

3.7 **Depth of Cover:** Minimum cover for underground piping is two feet unless indicated otherwise.

3.8 **Existing Pavement:** Where new piping passes below existing streets, driveways, parking lots, or other paved areas, the pavement shall be saw cut. Backfill shall be compacted to 95% density and the pavement shall be patched to match existing pavement. Provide compaction tests and reports as required.

3.9 **Landscape Restoration:**

3.9.1 **Lawn or Unpaved Areas:** The soil shall be replaced according to the original profile. Compact the top 6" of subgrade and each 6" layer of backfill or fill material at 85% maximum density for cohesive soils and 90% relative density for cohesionless soils.

If additional soil is required, the Contractor shall supply weed free topsoil of a type to match existing topsoil.

**END OF SECTION 22 05 63**
SECTION 22 07 00

INSULATION FOR PLUMBING EQUIPMENT AND PIPING

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-22 Basic Plumbing Materials and Methods Sections apply to work of this section.

1.3 Approval Submittals:

1.3.1 Product Data: Submit a producer's data sheets and installation instructions on each insulation system including insulation, coverings, adhesives, sealers, protective finishes, and other material recommended by the manufacturer for applications indicated. Submit for:

1.3.1.1 Fiberglass pipe insulation

1.3.1.2 Cellular glass pipe below ground insulation

1.3.1.3 Flexible unicellular piping insulation

1.4 O&M Data Submittals: Submit a copy of all approval submittals. Include in O&M Manual.

2 PRODUCTS

2.1 Acceptable Manufacturers: Subject to compliance with requirements, provide insulation products by Armstrong, Johns Manville, Knauf, Owens Corning, Pittsburgh Corning, U.S. Rubber, or approved equal. All products shall be asbestos-free.

2.2 Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics, and adhesive) with a flame-spread rating of 25 or less, and a smoke-developed rating of 50 or less, as tested by ANSI/ASTM E84.

2.3 Pipe Insulation Materials:

2.3.1 fiberglass Pipe Insulation: ASTM C547, Class 1 unless otherwise indicated. (Preformed sleeving with white all-service jacket, suitable for temperatures up to 450°F)

2.3.2 Cellular Glass Pipe Insulation: ASTM C552, Type II, Class 1. (Uncovered.)

2.3.3 Flexible Unicellular Pipe Insulation: ASTM C534, Type I. (Tubular, suitable for use to 200°F.)

2.3.4 Staples, Bands, Wires, and Cement: As recommended by the insulation manufacturer for applications indicated.

2.3.5 Adhesives, Sealers, Protective Finishes: Products recommended by the insulation manufacturer for the application indicated.

2.3.6 Jackets: ASTM C921, Type I (vapor barrier) for piping below ambient temperature, Type II (vapor permeable) for piping above ambient temperature. Type I may be used for all piping at Installer's option.

3 EXECUTION

3.1 General:

3.1.1 Install thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.
3.1.2 Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

3.1.3 Maintain integrity of vapor-barrier on insulation and protect it to prevent puncture and other damage. Label all insulation "ASBESTOS FREE".

3.1.4 Do not apply insulation to surfaces while they are hot or wet.

3.1.5 Do not install insulation until systems have been checked and found free of leaks. Surfaces shall be clean and dry before attempting to apply insulation. A professional insulator with adequate experience and ability shall install insulation.

3.1.6 Do not install insulation on pipe systems until acceptance tests have been completed except for flexible unicellular insulation. Do not install insulation until the building is "dried-in".

3.2 Fiberglass Pipe Insulation:

3.2.1 Insulate the following piping systems (indoor locations):

3.2.1.1 Domestic hot water, 141°-180° F: up to 1-1/4" pipe - 1½" thick, over 1-1/4" pipe 2" thick.

3.2.1.2 Domestic hot water, 105°-140° F: up to 3" pipe - 1½" thick, over 3" pipe - 2" thick.

3.2.2 Apply insulation to pipe with all side and end joints butted tightly. Seal longitudinal lap by pressurizing with plastic sealing tool. Apply 3 inch wide self sealing butt strips to joints between insulation sections. Insulate all fittings, flanges, valves and strainers with premolded insulation. Apply coat of insulating cement to fittings and wrap with glass cloth overlapping each wrap 1" and adjacent pipe 2". Finish with heavy coat of general purpose mastic. Premolded PVC covers may also be used, but no flexible inserts are allowed.

3.2.3 Provide hanger or pipe support shields of 16 gauge (minimum) galvanized steel over the insulation which extends halfway up the pipe insulation cover and at least 6" on each side of the hanger.

3.2.4 Omit insulation on exposed plumbing fixture runouts from faces of wall or floor to fixture; on unions, flanges, strainer blowoffs, flexible connections and expansion joints.

3.3 Cellular Glass Pipe Insulation (Underground):

3.3.1 Insulate the following piping systems:

3.3.1.1 Domestic hot water: smaller than 6" pipe -1½" thick, 6" and larger pipe -2" thick.

3.3.2 Cut insulation in sections at fittings and carefully fit to the pipe and fittings. No stovepipe or single miter insulation is allowed. Apply vapor barrier mastic to all edges of the cellular insulation and between joints in the insulation. Wire the cellular glass in place with stainless steel wire 9 inches on center. Finish with a prefabricated water barrier self-sealing jacket similar to Pittsburg Corning "Pittwrap SSII", 70 mils thickness. Insulate all anchors, guides, wall penetrations, expansion joints, loops and ells in accordance with the manufacturer's recommendations. Use rubber spacers at all expansion fittings.

3.4 Flexible Unicellular Pipe Insulation:

3.4.1 Insulate the following piping systems:

3.4.1.1 Air compressor after-cooler piping - ¾" thick.

3.4.2 Apply insulation in accordance with the manufacturer's recommendations and instructions. Mitre cut insulation to fit pipe fittings. Use approved cement to seal all joints and ends in the insulation.
SECTION 22 11 13
POTABLE WATER SYSTEM

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-22 Basic Plumbing Requirements and Basic Plumbing Materials and Methods sections apply to work of this section.

1.3 Extent of potable water systems work, is indicated on drawings and schedules, and by requirements of this section.

1.4 Refer to other Division-22 sections for site water distribution system; not work of this section unless noted.

1.5 Refer to appropriate Division-2 sections for exterior potable water system; not work of this section unless noted.

1.6 Insulation for potable water piping is specified in other Division-22 sections, and is included as work of this section. Insulation requirements include:

1.6.1 Domestic hot water piping

1.7 Excavation and backfill required in conjunction with water piping is specified in other Division-22 sections, and is included as work of this section.

1.8 Code Compliance: Comply with applicable portions of Florida Building Code-Plumbing pertaining to selection and installation of plumbing materials and products. Comply with local utility requirements.

1.9 Approval Submittals:

1.9.1 Product Data: Submit manufacturer's technical product data and installation instructions for:

Valves
Strainers
Hose bibbs
Wall hydrants
Water hammer arresters
Meters and gauges
Relief valves
Trap primers
Access doors

1.10 Test Reports and Verification Submittals:

1.10.1 Disinfection: Submit report by Health Department.

1.11 O&M Data Submittals: Submit a copy of all approval submittals. Submit maintenance data and parts
lists for valves, backflow preventers, pressure regulating valves, trap primers. Include these data in O&M manual.

2 PRODUCTS

2.1 General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with Florida Building Code-Plumbing where applicable. Provide sizes and types matching pipe materials used in potable water systems. Where more than one type of materials or products is indicated, selection is Installer’s option.

2.2 Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following listed for each item.

2.3 Identification: Provide identification complying with Division-22 Basic Plumbing Materials and Methods section "Plumbing Identification". Provide manufacturer’s standard permanent, bright-colored, continuous-printed plastic tape, intended for direct burial service; not less than 6” wide x 4 mils thick. Provide blue tape with black printing reading “CAUTION WATER LINE BURIED BELOW”.

2.4 Pipes and Fittings: Provide pipes and pipe fittings complying with Division-22 Basic Plumbing Materials and Methods section "Pipes and Pipe Fittings", in accordance with the following listing:

2.4.1 Interior Water Piping:

2.4.1.1 Above Grade: Copper tube; Type L, hard-drawn temper; wrought-copper fittings, solder-joints.

2.4.1.2 Below Grade: Copper tube; Type L, soft-annealed temper; no joints below floor.

2.4.2 Exterior Water Piping:

2.4.2.1 Copper tube; Type L, hard-drawn temper; wrought-copper fittings, solder-joints.

2.4.2.2 Polyvinyl chloride pipe (PVC), Schedule 4080; PVC socket fittings, solvent cement joints.

2.4.3 Solder joints shall be made with 95-5 solder.

2.5 Piping Specialties: Provide piping specialties complying with Division-22 Basic Plumbing Materials and Methods section "Piping Specialties".

2.6 Supports and Anchors: Provide supports and anchors complying with Division-22 Basic Plumbing Materials and Methods section "Supports and Anchors".

2.7 Interior Valves: Provide valves complying with Division-22 Basic Plumbing Materials and Methods section "Valves", in accordance with the following listing:

2.7.1 Sectional and Shutoff Valves: GA1, GA2, GA3, BA1, BA2.

2.7.2 Drain Valves: GA1, GA2, BA1, BA2.

2.7.3 Throttling Valves: GL1, GL2, BA1, BA2.

2.7.4 Check Valves: CK1, CK2, CK3.

2.8 Exterior Valves: Provide as indicated, gate valves, AWWA C500, 175 psi working pressure. Provide threaded, flanged, hub, or other end configurations to suit size of valve and piping connections. Provide inside screw type for use with curb valve box, iron body, bronze-mounted, double disc, parallel seat, non-rising stem. Clow Corp., Dresser Mfg., Fairbanks Co., Kennedy, Stockham.
2.9 **Hose Bibbs**: Provide rough nickel plated hose bibbs with lock shield compression stop and removable handle, solid flange, female connection with ¾” male threaded hose end, and straight line type non-removable vacuum breaker with ¾” male threaded hose end. Acorn 8121 RCP or equal model by Woodford.

2.10 **Non-freeze Wall Hydrants**: Provide ¾” anti-syphon, non-freeze wall hydrant with bronze casing, flush mounted stainless steel wall box, straight inlet connection, and integral vacuum breaker, dual check-backflow preventer, quarter turn full flow valve with wheel handle, stop valves. Acorn 8160 or approved equal.

2.11 **Water Hammer Arresters**: Provide bellows type water hammer arresters, stainless steel casing and bellows, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201. Precision Plumbing Products, Josam, Zurn, Amtrol, Wade, Jay R. Smith, or approved equal.

2.12 **Meters and Gauges**: Provide meters and gauges complying with Division-22 Basic Plumbing Materials and Methods section "Meters and Gauges", in accordance with the following listing:

- Thermometers
- Pressure gauges
- Calibrated balancing cocks

2.13 **Combined Pressure-Temperature Relief Valves**: Provide relief valves as indicated, of size and capacity as selected by Installer for proper relieving capacity, in accordance with ASME Boiler and Pressure Vessel Code. Provide bronze body, test lever and thermostat complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Provide temperature relief at 210°F, and pressure relief at 150 psi. Watts, Cash, Zurn, or approved equal.

2.14 **Trap Primers**: Provide brass trap primers and distribution units to seal floor drains indicated on drawings. Trap primer valves shall be automatic, self contained type with no springs or diaphragms and shall not require adjustment. Trap primer valves shall be the type that can be installed anywhere on cold water piping. Distribution units shall supply 1-4 floor drains. Trap primer valves shall comply with ASSE 1018. Precision Plumbing Products PR-500, or approved equal. Where P-trap primers are indicated use “Prime-Eze” by Jay R. Smith, or approved equal.

2.15 **Access Doors**: Provide access doors to service all valves and other devices as required in accordance with Division-22 Basic Materials and Methods Section “Access Doors”.

3 **EXECUTION**

3.1 **General**: Examine areas and conditions under which potable water systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 **Install plumbing identification** in accordance with Division-22 Basic Plumbing Materials and Methods section "Plumbing Identification". Install underground plastic pipe markers during backfill, 6”-8” below grade.

3.3 **Install water distribution piping** in accordance with Division-22 Basic Plumbing Materials and Methods section "Pipes and Pipe Fittings".

3.3.1 **Install piping** with 1/32” per foot (¼%) downward slope towards drain point.

3.3.2 **Locate groups of pipes** parallel to each other, spaced to permit applying full insulation and servicing of valves.

3.4 **Install exterior water piping** in compliance with local governing regulations. Water piping shall be installed with a minimum of 30 inches of cover unless otherwise indicated.
3.5 Install piping specialties in accordance with Division-22 Basic Plumbing Materials and Methods section "Piping Specialties".

3.6 Install supports and anchors in accordance with Division-22 Basic Plumbing Materials and Methods section "Supports and Anchors".

3.7 Install valves in accordance with Division-22 Basic Plumbing Materials and Methods section "Valves".

3.7.1 Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves two or more plumbing fixtures or equipment connections, and elsewhere as indicated.

3.7.2 Shutoff Valves: Install on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated.

3.7.3 Drain Valves: Install on each plumbing equipment item located to completely drain equipment for service or repair. Install at base of each riser, at base of each rise or drop in piping system, and elsewhere where indicated or required to completely drain potable water system.

3.7.4 Check Valves: Install where indicated.

3.7.5 Calibrated Balancing Cocks: Install in each hot water recirculating loop, and elsewhere as indicated.

3.8 Hose Bibbs and Wall Hydrants: Install on concealed piping where indicated with vacuum breaker. Mount 18 inches above grade or finished floor.

3.9 Install backflow preventers where indicated, and where required by Florida Building Code-Plumbing. Locate in same room as equipment being protected. Pipe relief outlet to nearest floor drain or outside as shown on the drawings. Provide test and report by State of Florida Certified Backflow Preventer Specialist.

3.10 Install pressure regulating valves where indicated. Provide inlet and outlet shutoff valves, and throttling valve bypass. Provide pressure gauge on valve outlet.

3.11 Install meters and gauges in accordance with Division-22 Basic Plumbing Materials and Methods section "Meters and Gauges".

3.12 Install relief valves on each water heater, and where indicated in accordance with the manufacturer's instructions. Pipe full size outside or to floor drain. Cut the end of the pipe at a 45° angle and terminate 6 inches above the floor or grade.

3.13 Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by Florida Building Code-Plumbing.

3.14 Plumbing Equipment Connections: Connect hot and cold water piping system to plumbing equipment as indicated, and comply with equipment manufacturer's installation instructions. Provide shutoff valve and union for each connection, provide drain valve on drain connection.

3.15 Install water hammer arresters in upright position, in locations and of sizes indicated in accordance with PDI Standard WH-201.

3.16 Install trap primers as indicated, and in accordance with manufacturer's installation instructions. Provide access panels to all trap primers unless accessible through a lay-in ceiling.

3.17 Locate and coordinate installation of access doors for all valves and devices in accordance with Division-23 Basic Mechanical Materials and Methods section "Access Doors".

3.18 Piping Tests: Test, clean, and sterilize potable water piping in accordance with testing requirements of Division-23 Basic Mechanical Materials and Methods section "Testing, Cleaning, and Sterilization of Piping Systems".

END OF SECTION 22 11 13
SECTION 22 13 16

SOIL, WASTE AND VENT SYSTEM

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-22 Basic Plumbing Requirements and Basic Plumbing Materials and Methods sections apply to work of this section.

1.3 Extent of soil waste and vent systems work is indicated on drawings and schedules, and by requirements of this section.

1.4 Refer to appropriate Division-2 sections for exterior sanitary sewer system required in conjunction with soil and waste systems; not work of this section.

1.5 Insulation for soil and waste systems is specified in other Division-22 sections, and is included as work of this section. Insulation requirements include:

1.5.1 Horizontal above grade waste pipes receiving discharge from ice machines, coolers, freezers or similar units to points of connection receiving waste from 4 or more fixtures.

1.5.2 Horizontal above grade waste pipes receiving condensate from air conditioning equipment to point of connection receiving waste from 4 or more fixtures.

1.6 Excavation and backfill required in conjunction with soil, waste and vent piping is specified in other Division-22 sections and is included as work of this section.

1.7 Refer to Division-7 section "Flashing and Sheet Metal" for flashings required in conjunction with soil and waste systems; not work of this section.

1.8 Code Compliance: Comply with applicable portions of Florida Building Code-Plumbing pertaining to plumbing materials, construction and installation of products. Comply with local utility requirements.

1.9 Approval Submittals:

1.9.1 Product Data: Submit manufacturer's technical product data for:

   Cleanouts

   Floor drains

1.10 O&M Data Submittals: Submit a copy of all approval submittals. Submit maintenance data and parts lists for oil separators and backwater valves. Include these data in O&M manual.

2 PRODUCTS

2.1 General: Provide piping materials and factory-fabricated piping products of sizes, types, pressure ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in soil and waste systems. Where more than one type of materials or products is indicated, selection is Installer's option.

Underground-Type Plastic Line Marker: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6" wide x 4 mils thick. Provide green tape with black printing reading "CAUTION SEWER LINE BURIED BELOW".
2.2 Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following listed for each item.

2.3 Pipes and Fittings: Provide pipes and pipe fittings complying with Division-22 Basic Plumbing Materials and Methods section "Pipes and Pipe Fittings", in accordance with the following listing:

2.3.1 Above Ground Soil, Waste, and Vent Piping:
2.3.1.1 Polyvinyl chloride plastic pipe (PVC); Type DWV; PVC plastic type DWV socket-type fitting, solvent cement joints. Do not use in fire-rated assemblies or return air plenums.

2.3.2 Underground Building Drain Piping (within 5 feet of the building):
2.3.2.1 Pipe Size 6" and Smaller: Polyvinyl chloride sewer pipe (PVC); Type DWV; PVC plastic type DWV socket-type.

2.4 Pipe Specialties: Provide piping specialties complying with Division-22 Basic Materials and Methods section "Piping Specialties".

2.5 Supports and Anchors: Provide supports and anchors complying with Division-23 Basic Mechanical Materials and Methods section "Supports and Anchors".

2.6 Cleanouts: Provide factory-fabricated drainage piping products of size and type indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and governing regulations. Josam, Jay R. Smith, Wade, Zurn.

2.6.1 Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1 countersunk head.

2.6.2 Cleanout for PVC Systems:
2.6.2.1 Floor Cleanouts: Cast-iron body with adjustable head, brass plug, and scoriated nick-brass cover. Furnish with carpet flange for carpeted floors. Furnish with recessed cover for tile floors. Furnish with clamping ring for floors with membrane. Wade W-6030 hub outlet for push-on.

2.6.2.2 Cleanouts in Piping: PVC cleanout adaptor with threaded PVC plug.

2.6.2.3 Wall Cleanouts: PVC cleanout adaptor with tapped, countersunk, threaded brass plug. Square 8.75"x8.75" hinged wall access cover, with scoriated nickel bronze finish.

2.6.2.4 Grade Cleanouts: PVC cleanout adaptor with countersunk, threaded brass plug. Wade W-8590-D plug. In sidewalks and other finished concrete, provide access cover frames with a non-tilting tractor cover. Wade W-7035-Z or equal.

2.6.2.5 Cleanouts in Paved Areas: Cast iron body, adjustable housing, ferrule with plug and round loose scoriated tractor cover. Wade W-8300-MF. Coordinate concrete depth at site with adjustable flange.

2.7 Floor Drains: Provide floor drains of size as indicated on drawings; and type, including features, as specified herein. Josam, Jay R. Smith, Wade, Zurn.

2.7.1 Floor Drains: Provide inside caulk bottom outlet or TY-Seal hub outlet with adaptor for cast iron trap installation and a 4” deep trap seal. Provide clamping rings for floors with membrane.

2.7.2 Strainer: Provide 5” satin-nickel bronze strainer.

2.7.3 Trap Primer Connection: Provide ½” trap primer tapping.

2.7.4 Funnel: Provide funnel where shown on the drawings.

2.7.5 Basis of Design: Zurn ZN-415 B.
3 EXECUTION

3.1 Examine substrates and conditions under which soil and waste systems are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 Piping Installation:

3.2.1 Install above grade soil and waste piping in accordance with Division-23 Basic Mechanical Materials and Methods section "Pipes and Pipe Fittings", and with Florida Building Code-Plumbing.

3.2.2 Install underground soil and waste pipes as indicated and in accordance with Florida Building Code-Plumbing. Lay underground piping beginning at low point of systems, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install required gaskets in accordance with manufacturer's recommendations for use of lubricants, cements, and other special installation requirements. Clean interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

3.2.3 Install building soil and vent piping pitched to drain at minimum slope of ¼" per foot (2%) for piping smaller than 3", and 1/8" per foot (1%) for piping 3" and larger.

3.3 Install piping specialties in accordance with Division-23 Basic Mechanical Materials and Methods section "Piping Specialties".

3.4 Install supports and anchors in accordance with Division-23 Basic Mechanical Materials and Methods section "Supports and Anchors".

3.5 Installation of Cleanouts: Install in above ground piping and building drain piping as indicated, as required by Florida Building Code-Plumbing; and at each change in direction of piping greater than 45°; at minimum intervals of 50' for piping 4" and smaller and 100' for larger piping; and at base of each vertical soil or waste stack. Install floor and wall cleanout covers for concealed piping, select type to match adjacent building finish.

3.5.1 Size: Cleanouts shall be full size up to 4". Piping over 4" shall have a reducing fitting to accommodate a 4" cleanout unless indicated otherwise on drawings.

3.5.2 Install cleanouts to allow adequate clearance for rodding.

3.5.3 Protect all finished surfaces of cleanouts with a suitable adhesive covering until construction is completed.

3.5.4 Cleanouts to Grade: Provide an 18" x 18" x 8" thick concrete pad around the cleanout. Set the cleanout ferrule, adapter, or access cover frame in the concrete as required. The cleanout shall be extended to the finished grade. The concrete pad shall slope away from the cleanout in all directions approximately one inch. Cover pad with fill to finished grade.

3.5.5 Cleanouts in Paved Areas: Provide concrete pad similar to cleanout to grade and coordinate concrete depth at site with adjustable flange. Access cover frames are required.

3.6 Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.

3.7 Vent Flashing Sleeves: Install on stack passing through roof, secure to stack flashing in accordance with manufacturer's instructions. For metal roofs, sleeves and flashing are by Division-7.

3.8 Installation of Floor Drains: Install floor drains in accordance with manufacturer's written instructions and in locations indicated.

3.8.1 Coordinate flashing work with work of waterproofing and adjoining substrate work.
3.8.2 Install floor drains at low points of surface areas to be drained, or as indicated. Set tops of drains flush with finished floor.

3.8.3 Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.

3.8.4 Position drains so that they are accessible and easy to maintain.

3.9 **Connection of Trap Primers:** Connect trap primers as indicated, and in accordance with manufacturer's installation instructions. Pitch piping towards drain trap, minimum of 1/8" per foot (1%). Adjust trap primer for proper flow.

3.10 **Piping Runouts to Fixtures:** Provide soil and waste piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated, but in no case smaller than required by Florida Building Code- Plumbing.

3.11 Test, clean, flush, and inspect soil and waste piping in accordance with requirements of Division-23 Basic Mechanical Materials and Methods section "Testing, Cleaning and Sterilization of Piping Systems".

**END OF SECTION 22 13 16**
SECTION 22 30 00
PLUMBING FIXTURES, EQUIPMENT, TRIM & SCHEDULE

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-22 Basic Plumbing Requirements and Basic Plumbing Materials and Methods sections apply to work of this section.

1.3 Extent of plumbing fixtures work required by this section is indicated on drawings and schedules, and by requirements of this section.

1.4 Refer to Division-26 sections for field-installed electrical wiring required for plumbing fixtures; not work of this section.

1.5 Codes and Standards:

1.5.1 Plumbing Fixture Standards: Comply with applicable portions of Florida Building Code-Plumbing pertaining to materials and installation of plumbing fixtures.

1.5.2 ANSI Standards: Comply with applicable ANSI standards pertaining to plumbing fixtures and systems.

1.5.3 PDI Compliance: Comply with standards established by PDI pertaining to plumbing fixture supports.

1.5.4 UL Listing: Construct plumbing fixtures requiring electrical power in accordance with UL standards and provide UL-listing and label.

1.5.5 ARI Compliance: Construct and install water coolers in accordance with ARI Standard 1010 "Drinking-Fountains and Self-Contained Mechanically-Refrigerated Drinking-Water Coolers", and provide Certification Symbol.

1.5.6 ANSI Compliance: Construct and install barrier-free plumbing fixtures in accordance with ANSI Standard A117.1 "Specifications for Making Buildings and Facilities Accessible To and Usable By Physically Handicapped People".

1.6 Approval Submittals:

1.6.1 Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, furnished specialties and accessories; and installation instructions. Submit manufacturer's assembly-type drawings indicating dimensions, roughing-in requirements, required clearances, and methods of assembly of components and anchorages. The submittal shall be organized by “fixture number” and each fixture package shall be so identified. Each fixture package shall include all of the required fitting and trim, even if such devices are used for more than one fixture.

1.7 O&M Data Submittals: Submit a copy of approval submittals. Submit maintenance data and parts lists for each type of plumbing fixture and accessory; including "trouble-shooting" maintenance guide. Include these data in O&M manual.

1.8 Handle plumbing fixtures carefully to prevent breakage, chipping and scoring fixture finish. Do not install damaged plumbing fixtures; replace and return damaged units to equipment manufacturer.

2 PRODUCTS

2.1 General: Provide factory-fabricated fixtures of type, style and material indicated. For each type fixture, provide trim, carrier, seats, and valves as specified. Where not specified, provide products as
recommended by manufacturer, and as required for complete installation. Where more than one type
is indicated, selection is Installer’s option; but, all fixtures of same type must be furnished by single
manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing
regulations.

2.2 Model Numbers: Basis of design model numbers of a particular manufacturer are listed in the fixture
schedule as an aid to contractors. Where conflicts between the model number and the written
description occur, the written description shall govern. Where acceptable manufacturers are listed,
products are subject to compliance with requirements.

2.3 Materials:

2.3.1 Provide materials which have been selected for their surface flatness and smoothness. Exposed
surfaces which exhibit pitting seam marks, roller marks, foundry sand holes, stains, decoloration, or
other surface imperfections on finished units are not acceptable.

2.3.2 All fixtures shall be white vitreous china unless otherwise specifically noted. Where enameled iron
fixtures are specified, they shall be furnished with acid resisting enamel.

2.3.3 Where fittings, trim and accessories are exposed or semi-exposed provide bright chrome-plated or
polished stainless steel units. Provide copper or brass where not exposed.

2.3.4 Stainless Steel Sheets: ASTM A 167, Type 302/304, hardest workable temper. Finish shall be No. 4,
bright, directional polish on exposed surfaces.

2.3.5 Vitreous China: High quality, free from fire cracks, spots, blisters, pinholes and specks; glaze exposed
surfaces, and test for crazing resistance in accordance with ASTM C 554.

2.3.6 Synthetic Stone: High quality, free from defects, glaze on exposed surfaces, stain resistant.

2.4 Plumbing Fittings, Trim and Accessories:

2.4.1 Faucets: At locations where water is supplied (by manual, automatic or remote control), provide
commercial quality chrome-plated, cast-brass faucets, valves, or other dispensing devices, of type and
size indicated, and as required to operate as indicated.

2.4.1.1 Automatic Faucets: Provide electronic sensor-operated faucets with 0.5 gpm vandal-resistant spray
head. Set volume adjustment at 0.25 gallons per operation. Provide box-mounted, hard-wired
transformer (120 VAC primary - 24 VAC secondary) with each faucet. All wiring and electrical
connections shall be provided by Division - 26.

2.4.1.2 Aerators: Provide aerators of types approved by Health Department having jurisdiction.

2.4.1.3 Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the
following for each item. American Standard, Chicago Faucet Co., Kohler Co., Speakman Co., T & S
Brass and Bronze Works, Water Saver Faucet Co.

2.4.2 Stops: Provide chrome-plated brass, angle type, manual shutoff valves and d” chrome-plated flexible
supply pipes to permit fixture servicing without shutdown of water supply piping systems for all fixtures.
Coordinate with fixture requirements.

2.4.2.1 Provide loose key stops.

2.4.2.2 Provide standard stops.

2.4.2.3 Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the
following for each item. Zurn or approved equal.
2.4.3 **Waste Outlets:** Provide removable P-traps, drains, waste arms, tailpieces and wastes-to-wall where drains are indicated for direct connection to drainage system for all fixtures unless otherwise noted. Provide drains, tailpieces and waste arms where indirect drains are indicated. Waste outlets shall be full size of fixture drain connection.

2.4.3.1 Provide chrome-plated cast-brass P-traps and drains with cleanout.

2.4.3.2 P-traps, wastes and drains of all types shall be 17-gauge.

2.4.3.3 **Acceptable Manufacturers:** Subject to compliance with requirements, provide products of one of the following for each item. Zurn, or approved equal.

2.4.4 **Flush Valves:** Provide quiet-flush, chrome-plated, cast-brass flush valves with vacuum breaker and screwdriver stop. Where handicap service is indicated, provide ADA compliant handles with the handle on the wide side of the stall.

2.4.4.1 **Automatic Flush Valves:** Provide self-adaptive, electronic, infrared-sensor operated flush valves with 24 volt solenoid operator and override button. Provide a box-mounted, hard-wired transformer (120 VAC primary - 24 VAC secondary) with each flush valve. Provide matching wall cover plates each with four vandal-resistant screws. All wiring and electrical connections shall be provided by Division - 26.

2.4.4.2 **Acceptable Manufacturers:** Subject to compliance with requirements, provide products of one of the following for each item. Sloan Valve Co. or Zurn.

2.4.5 **Carriers:** Provide cast-iron supports for fixtures of either graphitic gray iron, ductile iron, or malleable iron or steel as indicated. Coordinate with specific fixture requirements and conditions of the project.

2.4.5.1 **Acceptable Manufacturers:** Subject to compliance with requirements, provide products of one of the following for each item. Josam, Wade, Zurn, J.R. Smith.

2.4.6 **Fixture Bolt Caps:** Provide manufacturer's standard exposed fixture bolt caps finished to match fixture finish.

2.4.7 **Escutcheons:** Where fixture supplies and drains penetrate walls in exposed locations, provide chrome-plated brass escutcheons with friction clips.

2.4.8 **Comply** with additional fixture requirements listed for each fixture and as required for a complete and functional system.

2.5 **Water Closets:**

2.5.1 **General:** Provide white china siphon jet type unless otherwise noted.

2.5.1.1 **Acceptable Manufacturers:** Subject to compliance with requirements, provide products of one of the following for each item. American Standard, Crane, Kohler, or Zurn.

2.5.2 **Fixture Seats:** Provide white, heavy molded plastic fixture seats with stainless steel self-sustaining check hinges.

2.5.2.1 **Acceptable Manufacturers:** Subject to compliance with requirements, provide products of one of the following for each item. Bemis Mfg. Co., Beneke Corp., Church or Comfort Seats.

2.5.3 **Water Closet Schedule:**

WC-1 WATER CLOSET, FLOOR-MOUNT (HANDICAP, TANK TYPE):
Vitreous china low consumption 1.28 GPF, elongated, siphon jet action, closed-coupled tank, complete with float valve, valve and chrome plated trip lever, bolt caps, color “white”, chrome plated angle stop with flexible supply. Heavy molded plastic, white, elongated, open front seat less cover, with stainless steel, self-sustaining check hinges.

Water closet  
Zurn Z5555-K HET  
Supply w/stop  
Zurn Z8800CRLK-PC  
Seat  
Zurn Z5955SS-EL-STS  
Closet Bolt/Wax Ring Kit  
Zurn Z5972-COMB

2.6 Lavatories:

2.6.1 General: Provide white china lavatories.

2.6.2 Acceptable Manufacturers: Subject to compliance with requirements, provide products of one of the following for each item. American Standard, Crane, Kohler, or Zurn.

2.6.3 Lavatory Schedule:

L-1 LAVATORY, WALL-MOUNT (HANDICAP):

Vitreous china 20" x 18", color “white”, center hole setting, front overflow, for concealed arm support. Furnish floor-mounted single carrier with concealed arms, leveling and securing screws, structural uprights and block bases, secure base to floor for rigid connection with 1/2" x 3-3/4" threaded zinc plated steel heavy duty wedge anchors, complete with stainless steel clip, washer and threaded nut. Provide chrome plated angle stop to wall with chrome plated 3/8" flexible supply and loose key operator, integral perforated cast brass strainer with elbow and 1-1/4" offset tailpiece, chrome plated 17 gauge cast brass P-trap with cleanout and tube waste to wall. Polished chrome plated cast brass single water metering faucet with cover plate, aerator outlet and push button. Lavatory P-trap and angle valve assemblies shall be insulated with fully molded insulation kit, and light gray color with 3-piece interlocking rap assembly and 2-piece interlocking angle valve assembly. Fasteners shall be nylon-type supplied with kit. Lavatory shall be mounted with a clearance of at least 28" from floor to bottom of the apron. Knee and toe clearances shall be as follows: 27" clear height shall be provided from finished floor to a point on underside of bowl 8" in from front apron. Toe clearance shall be a minimum height of 9" under P-trap and supplies or stops. See Architectural drawings for final mounting height. Under sink 3/8" compression fitting mixing valve, bronze body, limits hot water between 80ºF & 120ºF, dual check valves, 40 mesh stainless steel strainer, tamper resistant locking cap. Meets ASSE 1070 standards.

Lavatory  Zurn Z5341  
Faucet  Zurn Z-86300  
Supply w/stop  Zurn Z8802LRLK-PC  
P-Trap  Zurn Z8700-PC  
Strainer/tailpiece  Zurn Z8746  
Insulation kit  Zurn Z8946-3-NT  
Aerator  Zurn -5M  
Carrier  Zurn Z-1231-D  
Base Anchorage  B-Line Anchors AWA-50-375  
Mixing Valve  Watts LFUSG-B

2.7 Electric Water Coolers:

2.7.1 General: Provide self-contained electric water cooler with entire water system free of lead. All joints shall
be made using silver solder. Units shall be complete with an air-cooled refrigeration system consisting of a hermetic compressor, cooler, pre-cooler, condenser fan, thermostat safety controls and all other related devices. The unit shall have a capacity of 8 gallons per hour. The cabinet shall be stainless steel with vermin proof insulation. The top shall be fabricated of stainless steel with a No. 4 finish. Provide sensor, operator, transformer and all related controls for fully automatic operation. Where handicap units are indicated, the bubbler and fountain shall be ADA compliant.

2.7.2 **Acceptable Manufacturers:** Subject to compliance with requirements, provide products of one of the following for each item. Elkay Mfg. Co., Halsey Taylor Div., Haws Drinking Faucet Co., Sunroc, Oasis.

2.7.3 **Electric Water Cooler Schedule:**

**EWC-1 ELECTRIC WATER COOLER (HANDICAP):**

Wall hung, self-contained electric water cooler. Furnish floor-mounted single carrier with bearing plate, hanger plate. Adjustable supporting rods, structural uprights and block bases. Unit to be complete with hermetic air-cooled refrigeration system, cooler pre-cooler, thermostat, safety controls, condenser fan motor, vermin proof insulation, stainless steel cabinet, quiet operation. Top of cooler shall be No. 3 finish stainless steel, two-stream anti-squirt projector with one-piece chrome plated hood guard, and front and side push bar controls. Cooler capacity shall be 8.0 gph, cooling 80-degree F water to 50 degree F. Provide one-year warranty on entire cooler. Provide chrome plated stop to wall with chrome plated 3/8" flexible supply. Provide 1-1/4" chrome plated 17 gauge cast brass P-trap with cleanout and tube waste to wall. 120V, single phase, 3.3 full load amps, 265 rated watts, 1/6 compressor hp. Mount to satisfy ADA requirements, verify final location, mounting height and finish with Architectural drawings.

<table>
<thead>
<tr>
<th>EDF</th>
<th>Elkay LZS8WSSP</th>
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<tbody>
<tr>
<td>P-trap</td>
<td>Zurn Z8700-PC</td>
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<tr>
<td>Carrier</td>
<td>Zurn Z-1225</td>
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<tr>
<td>EDF</td>
<td>Elkay EZTLR8C</td>
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<tr>
<td>Trap</td>
<td>Zurn Z-8700-PC</td>
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<tr>
<td>Carrier</td>
<td>Z1225 BL</td>
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2.8 **Mop Receptors:**

2.8.1 **General:** Provide one piece mop receptors with 3" integral stainless steel grid drain. Provide wall-mounted faucet with arm handles, vacuum breaker, stops, hose connection and hose bracket. Provide 30" hose.

2.8.2 **Acceptable Manufacturers:** Subject to compliance with requirements, provide products of one of the following for each item. Stern-Williams Co., or Acorn.

2.8.3 **Mop Receptor Schedule:**

**MR-1 SERVICE SINK (FLOOR TYPE):**

36” X 24” terrazzo with stainless steel caps, corner type, floor mount. Rough chrome plated faucet with top brace on 8” centers, bucket hook, vacuum breaker, stops and hose end, 3” outlet drain with strainer. Chrome plated loose key angle stop to wall with 3/8” chrome plated flexible hot and cold water supplies.

| Sink | Acorn TSH-3624-TF2 |
| Faucet | Zurn Z843 M1 RC |
| Supply | Zurn Z-8800-LRLK |
2.9 **Water Heaters:**

2.9.1 **Electric Water Heaters:**

**EWH-1 ELECTRIC WATER HEATER:**

ASHRAE Standard 90, glass lined tank Suitable for 150 psi working pressure, 300-psi test. Finish of durable high gloss baked enamel. Blanket glass fiber insulation over entire tank. ASME pressure and temperature relief valve. Water heater shall be acceptable for commercial application by manufacturer. Provide 3 full year warranty, snap action automatic surface mounted thermostats, immersion type heating elements and magnesium anode rod. Provide unit mounted disconnect switch. Provide thermal expansion relief valve on cold water inlet side of heater for thermal expansion control. Provide galvanized steel drip pan. 2.5 KW, 277 volts, single phase, coordinate with electrical.

- Water Heater: A. O. Smith DEL 10S
- Vacuum Relief: Watts 36A
- Expansion Relief Valve: Watts 530

**IWH-1 INSTANTANEOUS WATER HEATER:**

Electric, thermostatic, tankless water heater, low activation of 0.3 gpm turn on flow, nichrome heating element or approved equal. Connect with 3/8” copper pipe at inlet and outlet. Provide with flow control and flow switch devices. All parts shall be field replaceable. Unit shall be rated for 277 volts, single phase, coordinate with electrical.

- Water Heater: Eemax Accumix AM008277T

2.9.2 **Accessories:** VB, relief, pan, stand, etc.

2.9.3 **Acceptable Manufacturers:** Subject to compliance with requirements, provide products of one of the following for each item. Ruud, Rheem, Mor-Flo, State, A.O. Smith.

2.10 **Thermostatic Mixing Valves:**

2.10.1 **General:**

2.10.2 **Acceptable Manufacturers:** Subject to compliance with requirements, provide products of one of the following for each item.

2.10.3 **Thermostatic Mixing Valve Schedule:**

**MV-1 WATER MIXING VALVE (THERMOSTATIC MIXING):**

Under sink 3/8” compression fitting mixing valve, bronze body, limits hot water between 80°F & 120°F, dual check valves, 40 mesh stainless steel strainer, tamper resistant locking cap. Meets ASSE 1070 standards.

- Exposed Mixing Valve: Watts LFUSG-B

2.11 **Emergency Showers and Eyewashes:**

2.11.1 **General:**
2.11.2 **Acceptable Manufacturers:** Subject to compliance with requirements, provide products of one of the following for each item. Bradley Corp., Western, Water Saver Faucet Co.

**EW-1 EMERGENCY EYE/FACE WASH:**

Wall mount stainless steel bowl with flip top dust caps. Stay-open ball valve manually operated by stainless steel press bar clearly marked push to activate valve. Provide chrome plated 1/2" cold water supply. Tie 1-1/4" tailpiece into chrome plated 17 gauge cast brass P-trap with cleanout. Furnish with heavy gauge metal wall bracket anchored to concealed solid backing for a rigid connection, lateral movement shall be minimal.

- Eye/Face wash
  - Guardian G-1750
- Supplies
  - Zurn Z-8800-LR-LK
- Trap
  - Zurn Z-8700-PC

2.12 **Miscellaneous Fixtures:**

2.12.1 **General:**

2.12.2 **Acceptable Manufacturers:** Provide products of one of the manufacturer listed or equal.

**HR-1 RETRACTABLE HOSE REEL (COMPRESSED AIR):**

Open reel, hand crank hose reel with 50'-0" of 1/2" I.D. rubber hose. Mount below ceiling approximately 6'-6" above floor. Coordinate final locations with owner prior to rough-in. Coordinate exact location with owner prior to rough-in.

- Hose reel
  - REELCRAFT CT8050LN

**AC-1 AIR COMPRESSOR:**

Simplex, horizontal, 120 gallon, 10 HP, two stage lubricated heavy-duty industrial duty cycle air compressor with a maximum operating pressure of 175 PSI, maximum free air 34.8 CFM. Equipped with ASME air receiver, ASME pressure relief valve, three phase electric motor, pressure switch for start/stop control, needle valve, pilot valve and head unloaders for continuous run capability. Unit shall be rated for 460 volts, 3 phase operation – coordinate with electrical.

- Air Compressor
  - Speedaire IWD88

3 **EXECUTION**

3.1 Examine roughing-in work of potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures. Also examine floors and substrates, and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping, and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 Install plumbing fixtures of types indicated where shown and at indicated heights. Install in accordance with fixture manufacturer's written instructions, roughing-in drawings, and with recognized industry practices. Install in accordance with ADA and applicable handicap code requirements. Ensure that plumbing fixtures comply with requirements and serve intended purposes. Comply with applicable

3.3 Fasten plumbing fixtures securely to indicated supports or building structure; and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid, and not subject to pull or push movement. Mount at heights shown on the drawings. Fixture heights are floor-to-rim distance. Fitting heights are to centerline.

3.4 Install stop valve in water supply to each fixture.

3.5 After fixtures are set, the crack between the fixture and wall shall be caulked with DAP silicone-based caulking, or approved equal.

3.6 Protect installed fixtures from damage during remainder of construction period.

3.7 Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

3.8 Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by Architect/Engineer. Remove cracked or dented units and replace with new units.

3.9 Clean plumbing fixtures, trim, aerators, and strainers of dirt and debris upon completion of installation.

3.10 Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow stream and specified gpm.

3.11 Adjust or replace washers to prevent leaks at faucets and stops.

END OF SECTION 22 30 00
1 GENERAL

1.1 The work covered by this division consists of providing all labor, equipment and materials and performing all operations necessary for the installation of the mechanical work as herein called for and shown on the drawings.

1.2 Related Documents:

1.2.1 Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to work of this section.

1.2.2 This is a Basic Mechanical Requirements Section. Provisions of this section apply to work of all Division 23 sections.

1.2.3 Review all other contract documents to be aware of conditions affecting work herein.

1.2.4 Definitions:

1.2.4.1 Provide: Furnish and install, complete and ready for intended use.

1.2.4.2 Furnish: Supply and deliver to project site, ready for subsequent requirements.

1.2.4.3 Install: Operations at project site, including unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar requirements.

1.3 Permits and Fees: Contractor shall obtain all necessary permits, meters, and inspections required for his work and pay all fees and charges incidental thereto.

1.4 Verification of Owner's Data: Prior to commencing any work the Contractor shall satisfy himself as to the accuracy of all data as indicated in these plans and specifications and/or as provided by the Owner. Should the Contractor discover any inaccuracies, errors, or omissions in the data, he shall immediately notify the Architect/Engineer in order that proper adjustments can be anticipated and ordered. Commencement by the Contractor of any work shall be held as an acceptance of the data by him after which time the Contractor has no claim against the Owner resulting from alleged errors, omissions or inaccuracies of the said data.

1.5 Delivery and Storage of Materials: Materials delivered to site shall be inspected for damage, unloaded, and stored with a minimum of handling. All material shall be stored to provide protection from the weather and accidental damage.

1.6 Extent of work is indicated by the drawings, schedules, and the requirements of the specifications. Singular references shall not be construed as requiring only one device if multiple devices are shown on the drawings or are required for proper system operation.

1.7 Field Measurements and Coordination:

1.7.1 The intent of the drawings and specifications is to obtain a complete and satisfactory installation. Separate divisional drawings and specifications shall not relieve the Contractor or subcontractors from full compliance of work of his trade indicated on any of the drawings or in any section of the specifications.

1.7.2 Verify all field dimensions and locations of equipment to insure close, neat fit with other trades' work. Make use of all contract documents and approved shop drawings to verify exact dimension and locations.
1.7.3 Coordinate work in this division with all other trades in proper sequence to insure that the total work is completed within contract time schedule and with a minimum cutting and patching.

1.7.4 Locate all apparatus symmetrical with architectural elements. Install to exact height and locations when shown on architectural drawings. When locations are shown only on mechanical drawings, be guided by architectural details and conditions existing at job and correlate this work with that of others.

1.7.5 Install work as required to fit structure, avoid obstructions, and retain clearance, headroom, openings and passageways. Cut no structural members without written approval.

1.7.6 Carefully examine any existing conditions, piping, and premises. Compare drawings with existing conditions. Report any observed discrepancies. It shall be the Contractor's responsibility to properly coordinate the work and to identify problems in a timely manner. Written instructions will be issued to resolve discrepancies.

1.7.7 Because of the small scale of the drawings, it is not possible to indicate all offsets and fittings or to locate every accessory. Drawings are essentially diagrammatic. Study carefully the sizes and locations of structural members, wall and partition locations, trusses, and room dimensions and take actual measurements on the job. Locate piping, ductwork, equipment and accessories with sufficient space for installing and servicing. Contractor is responsible for accuracy of his measurements and for coordination with all trades. Contractor shall not order materials or perform work without such verification. No extra compensation will be allowed because field measurements vary from the dimensions on the drawings. If field measurements show that equipment or piping cannot be fitted, the Architect/Engineer shall be consulted. Remove and relocate, without additional compensation, any item that is installed and is later found to encroach on space assigned to another use.

1.8 Guarantee:

1.8.1 The Contractor shall guarantee labor, materials and equipment for a period of one (1) year from Final Completion, or from Owner's occupancy, whichever is earlier. Contractor shall make good any defects and shall include all necessary adjustments to and replacement of defective items without expense to the Owner.

1.8.2 Owner reserves right to make emergency repairs as required to keep equipment in operation without voiding Contractor's Guarantee Bond nor relieving Contractor of his responsibilities during guarantee period.

1.9 Approval Submittals:

1.9.1 When approved, the submittal control log and submittals shall be an addition to the specifications herewith, and shall be of equal force in that no deviation will be permitted except with the approval of the Architect/Engineer.

1.9.1.1 Shop drawings, product literature, and other approval submittals will only be reviewed if they are submitted in full accordance with the General and Supplementary Conditions and Division 1 Specification sections and the following.

1.9.1.1.1 Submittals shall be properly organized in accordance with the approved submittal control log.

1.9.1.1.2 Submittals shall not include items from more than one specification section in the same submittal package unless approved in the submittal control log.

1.9.1.1.3 Submittals shall be properly identified by a cover sheet showing the project name, Architect and Engineer names, submittal control number, specification section, a list of products or item names with model numbers in the order they appear in the package, and spaces for approval stamps. A sample cover sheet is included at the end of this section.

1.9.1.1.4 Submittals shall have been reviewed and approved by the General Contractor (or Prime Contractor). Evidence of this review and approval shall be an "Approved" stamp with a signature and date on the cover sheet.
1.9.1.1.5 Submittals that include a series of fixtures or devices (such as plumbing fixtures or valves) shall be organized by the fixture number or valve type and be marked accordingly. Each fixture must include all items associated with that fixture regardless of whether or not those items are used on other fixtures.

1.9.1.1.6 The electrical design shown on the drawings supports the mechanical equipment basis of design specifications at the time of design. If mechanical equipment is submitted with different electrical requirements, it is the responsibility of the mechanical contractor to resolve all required electrical design changes (wire and conduit size, type of disconnect or overload protection, point(s) of connection, etc.) and clearly show the new electrical design on the mechanical submittal with a written statement that this change will be provided at no additional cost. Mechanical submittals made with no written reference to the electrical design will be presumed to work with the electrical design. Any corrections required will be at no additional cost.

1.9.2 If the shop drawings show variation from the requirements of contract because of standard shop practice or other reasons, the Contractor shall make specific mention of such variation in writing in his letter of transmittal and on the submittal cover sheet in order that, if acceptable, Contractor will not be relieved of the responsibility for executing the work in accordance with the contract.

1.9.3 Review of shop drawings, product literature, catalog data, or schedules shall not relieve the Contractor from responsibility for deviations from contract drawings or specifications, unless he has in writing called to the attention of the Architect/Engineer each such deviation in writing at the time of submission, nor shall it relieve him from responsibility for errors of any sort in shop drawings, product literature, catalog data, or schedules. Any feature or function specified but not mentioned in the submittal shall be assumed to be included per the specification.

1.9.4 Submit shop drawings as called for in other sections after award of the contract and before any material is ordered or fabricated. Shop drawings shall consist of plans, sections, elevations and details to scale (not smaller than ¼” per foot), with dimensions clearly showing the installation. Direct copies of small scale project drawings issued to the Contractor are not acceptable. Drawings shall take into account equipment furnished under other sections and shall show space allotted for it. Include construction details and materials.

1.10 Test Reports and Verification Submittals: Submit test reports, certifications and verification letters as called for in other sections. Contractor shall coordinate the required testing and documentation of system performance such that sufficient time exists to prepare the reports, submit the reports, review the reports and take corrective action within the scheduled contract time.

1.11 O&M Data Submittals: Submit Operation and Maintenance data as called for in other sections. When a copy of approval submittals is included in the O&M Manual, only the final “Approved” or “Approved as Noted” copy shall be used. Contractor shall organize these data in the O&M Manuals tabbed by specification number. Prepare O&M Manuals as required by Division 1 and as described herein. Submit manuals at the Substantial Completion inspection.

2 PRODUCTS

2.1 All materials shall be new or Owner-supplied reused as shown on the drawings, the best of their respective kinds, suitable for the conditions and duties imposed on them at the building and shall be of reputable manufacturers. The description, characteristics, and requirements of materials to be used shall be in accordance with qualifying conditions established in the following sections.

2.2 Equipment and Materials:

2.2.1 Shall be new and the most suitable grade for the purpose intended. Equipment furnished under this division shall be the product of a manufacturer regularly engaged in the manufacture of such items for a period of three years. Where practical, all of the components shall be products of a single manufacturer in order to provide proper coordination and responsibility. Where required, Contractor shall furnish proof of installation of similar units or equipment.
2.2.2 Each item of equipment shall bear a name plate showing the manufacturer's name, trade name, model number, serial number, ratings and other information necessary to fully identify it. This plate shall be permanently mounted in a prominent location and shall not be concealed, insulated or painted.

2.2.3 The label of the approving agency, such as UL, IBR, ASME, ARI, AMCA, by which a standard has been established for the particular item shall be in full view.

2.2.4 The equipment shall be essentially the standard product of a manufacturer regularly engaged in the production of such equipment and shall be a product of the manufacturer's latest design.

2.2.5 A service organization with personnel and spare parts shall be available within two hours for each type of equipment furnished.

2.2.6 Install in accordance with manufacturer's recommendations. Place in service by a factory trained representative where required.

2.2.7 Materials and equipment are specified herein by a single or by multiple manufacturers to indicate quality, material and type of construction desired. Manufacturer's products shown on the drawings have been used as basis for design; it shall be the Contractor's responsibility to ascertain that alternate manufacturer's products, or the particular products of named manufacturers, meet the detailed specifications and that size and arrangement of equipment are suitable for installation.

2.2.8 Model Numbers: Catalog numbers and model numbers indicated in the drawings and specifications are used as a guide in the selection of the equipment and are only listed for the contractor's convenience. The contractor shall determine the actual model numbers for ordering materials in accordance with the written description of each item and with the intent of the drawings and specifications.

2.2.9 All equipment and material shall be manufactured and assembled in the United States.

2.3 Requests for Substitution:

2.3.1 Where a particular system, product or material is specified by name, consider it as standard basis for bidding, and base proposal on the particular system, product or material specified.

2.3.2 Requests by Contractor for substitution will be considered only when reasonable, timely, fully documented, and qualifying under one or more of the following circumstances.

2.3.2.1 Required product cannot be supplied in time for compliance with Contract time requirements.

2.3.2.2 Required product is not acceptable to governing authority, or determined to be non-compatible, or cannot be properly coordinated, warranted or insured, or has other recognized disability as certified by Contractor.

2.3.2.3 Substantial cost advantage is offered Owner after deducting offsetting disadvantages including delays, additional compensation for redesign, investigation, evaluation and other necessary services and similar considerations.

2.3.3 All requests for substitution shall contain a "Comparison Schedule" and clearly and specifically indicate any and all differences or omissions between the product specified as the basis of design and the product proposed for substitution. Differences shall include but shall not be limited to data as follows for both the specified and substituted products:

Principal of operation.
Materials of construction or finishes.
Thickness of gauge of materials.
Weight of item.
Deleted features or items.
Added features or items.
Changes in other work caused by the substitution.
Performance curves.
If the approved substitution contains differences or omissions not specifically called to the attention of the Architect/Engineer, the Owner reserves the right to require equal or similar features to be added to the substituted products (or to have the substituted products replaced) at the Contractor's expense.

3  EXECUTION

3.1 Workmanship: All materials and equipment shall be installed and completed in a first-class workmanlike manner and in accordance with the best modern methods and practice. Any materials installed which do not present an orderly and reasonably neat and/or workmanlike appearance, or do not allow adequate space for maintenance, shall be removed and replaced when so directed by the Architect/Engineer.

3.2 Coordination:

3.2.1 The Contractor shall be responsible for full coordination of the mechanical systems with shop drawings of the building construction so the proper openings and sleeves or supports are provided for piping, ductwork, or other equipment passing through slabs or walls.

3.2.2 Any additional steel supports required for the installation of any mechanical equipment, piping, or ductwork shall be furnished and installed under the section of the specifications requiring the additional supports.

3.2.3 It shall be the Contractor's responsibility to see that all equipment such as valves, dampers, filters and such other apparatus or equipment that may require maintenance and operation are made easily accessible, regardless of the diagrammatic location shown on the drawings.

3.2.4 All connections to fixtures and equipment shown on the drawings shall be considered diagrammatic unless otherwise indicated by detail. The actual connections shall be made to fully suit the requirements of each case and adequately provide for expansion and servicing.

3.2.5 The contractor shall protect equipment, material, and fixtures at all times. He shall replace all equipment, material, and fixtures which are damaged as a result of inadequate protection.

3.2.6 Prior to starting and during progress of work, examine work and materials installed by others as they apply to work in this division. Report conditions which will prevent satisfactory installation.

3.2.7 Start of work will be construed as acceptance of suitability of work of others.

3.3 Interruption of Service: Before any equipment is shut down for disconnecting or tie-ins, arrangements shall be made with the Architect/Engineer and this work shall be done at the time best suited to the Owner. This will typically be on weekends and/or holidays and/or after normal working hours. Services shall be restored the same day unless prior arrangements are made. All overtime or premium costs associated with this work shall be included in the base bid.

3.4 Phasing: Provide all required temporary valves, piping, ductwork, equipment and devices as required. Maintain temporary services to areas as required. Remove all temporary material and equipment on completion of work unless Engineer concurs that such material and equipment would be beneficial to the Owner on a permanent basis.

3.5 Cutting and Patching: Notify General Contractor to do all cutting and patching of all holes, chases, sleeves, and other openings required for installation of equipment furnished and installed under this section. Utilize experienced trades for cutting and patching. Obtain permission from Architect/Engineer before cutting any structural items.

3.6 Equipment Setting: Bolt equipment directly to concrete pads or vibration isolators as required, using hot-dipped galvanized anchor bolts, nuts and washers. Level equipment.
3.7 **Painting:** Touch-up factory finishes on equipment located inside and outside shall be done under Division 23. Obtain matched color coatings from the manufacturer and apply as directed. If corrosion is found during inspection on the surface of any equipment, clean, prime, and paint, as required.

3.8 **Clean-up:** Thoroughly clean all exposed parts of apparatus and equipment of cement, plaster, and other materials and remove all oil and grease spots. Repaint or touch up as required to look like new. During progress of work, contractor is to carefully clean up and leave premises and all portions of building free from debris and in a clean and safe condition.

3.9 **Start-up and Operational Test:** Start each item of equipment in strict accordance with the manufacturer's instructions; or where noted under equipment specification, start-up shall be done by a qualified representative of the manufacturer. Alignment, lubrication, safety, and operating control shall be included in start-up check.

3.10 **Climate Control:** Operate heating and cooling systems as required after initial startup to maintain temperature and humidity conditions to avoid freeze damage and warping or sagging of ceilings and carpet.

3.11 **Record Drawings:**

3.11.1 During the progress of the work the Contractor shall record on their field set of drawings the exact location, as installed, of all piping, ductwork, equipment, and other systems which are not installed exactly as shown on the contract drawings.

3.11.2 Upon completion of the work, record drawings shall be prepared as described in the General Conditions, Supplementary Conditions, and Division 1 sections.

3.12 **Acceptance:**

3.12.1 **Punch List:** Submit written confirmation that all punch lists have been checked and the required work completed.

3.12.2 **Instructions:** At completion of the work, provide a competent and experienced person who is thoroughly familiar with project, for one day to instruct permanent operating personnel in operation of equipment and control systems. This is in addition to any specific equipment operation and maintenance training.

3.12.3 **Operation and Maintenance Manuals:** Furnish four complete manuals bound in ring binders with Table of Contents, organized, and tabbed by specification section. Manuals shall contain:

- Detailed operating instructions and instructions for making minor adjustments.
- Complete wiring and control diagrams.
- Routine maintenance operations.
- Manufacturer's catalog data, service instructions, and parts lists for each piece of operating equipment.
- Copies of approved submittals.
- Copies of all manufacturer's warranties.
- Copies of test reports and verification submittals.

3.12.4 **Record Drawings:** Submit record drawings.

3.12.5 **Test and Balance Report:** Submit four certified copies. The Report shall be submitted for review prior to the Substantial Completion Inspection unless otherwise required by Division 1.

3.12.6 Acceptance will be made on the basis of tests and inspections of job. A representative of firm that performed test and balance work shall be in attendance to assist. Contractor shall furnish necessary mechanics to operate system, make any necessary adjustments and assist with final inspection.

3.12.7 **Control Diagrams:** Frame under glass and mount on equipment room wall.

**END OF SECTION 23 01 00**

230100-6 MECHANICAL GENERAL
SECTION 23 05 20

PIPES AND PIPE FITTINGS

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-23 section making reference to pipes and pipe fittings specified herein.

1.3 Extent of pipes and pipe fittings required by this section is indicated on drawings and/or specified in other Division-23 sections.

1.4 Codes and Standards:

1.4.1 Welding: Qualify welding procedures, welders and operators in accordance with ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of piping work.

1.4.2 Brazing: Certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job-site brazing of piping work.

1.4.3 NSF Labels: Where plastic piping is indicated to transport potable water, provide pipes and pipe fittings bearing approval label by National Sanitation Foundations (NSF).

1.5 Test Report and Verification Submittals:

1.5.1 Submit welding certification for all welding installers.

1.5.2 Submit brazing certification for all brazing installers.

2 PRODUCTS

2.1 Piping Materials: Provide pipe and tube of type, joint type, grade, size and weight (wall thickness or Class) indicated for each service. Where type, grade or class is not indicated, provide proper selection as determined by Installer for installation requirements, and comply with governing regulations and industry standards.

2.2 Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with pipe manufacturer's recommendations where applicable.

2.3 Piping Materials/Products:

2.3.1 Soldering Materials:

2.3.1.1 Tin-Antimony (95-5) Solder: ASTM B-32, Grade 95TA.

2.3.1.2 Silver-Phosphorus Solder: ASTM B-32, Grade 96TS.

2.3.2 Pipe Thread Tape: Teflon tape.

2.3.3 Protective Coating: Koppers Bitumastic No. 505 or equal.

2.3.4 Gaskets for Flanged Joints: ANSI B16.21; full-faced for cast iron flanges; raised-face for steel flanges, unless otherwise noted.
2.3.5 **Welding Materials**: Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials. Materials shall be determined by installer to comply with installation requirements.

2.3.6 **Brazing Materials**: Silver content of not less than 15%. Materials shall be determined by installer to comply with installation requirements.

2.4 **Copper Tube and Fittings**:

2.4.1 **Copper Tube**:

2.4.1.1 **Copper Tube**: ASTM B88; Type K or L as indicated for each service; hard-drawn temper unless specifically noted as annealed.

2.4.1.2 **ACR Copper Tube**: ASTM B280.

2.4.1.3 **DWV Copper Tube**: ASTM B306.

2.4.2 **Fittings**:

2.4.2.1 **Wrought-Copper Solder-Joint Fittings**: ANSI B16.22.

2.4.2.2 **Copper Tube Unions**: Provide standard products recommended by manufacturer for use in service indicated.

2.4.2.3 **Wrought-Copper Solder-Joint Drainage Fittings**: ANSI B16.29.

2.4.2.4 **Cast-Copper Flared Tube Fittings**: ANSI B16.26.

2.5 **Steel Pipes and Pipe Fittings**

2.5.1 **Pipes**:

2.5.1.1 **Black Steel Pipe**: ASTM A-53 or A-120, seamless.

2.5.1.2 **Galvanized Steel Pipe**: ASTM A-53 or A-120, seamless.

2.5.2 **Pipe Fittings**:

2.5.2.1 **Threaded Cast Iron**: ANSI B16.4.

2.5.2.2 **Threaded Malleable Iron**: ANSI B16.3; plain or galvanized as indicated.

2.5.2.3 **Malleable Iron Threaded Unions**: ANSI B16.39; selected by installer for proper piping fabrication and service requirements including style, end connections, and metal-to-metal seats (iron, bronze or brass); plain or galvanized as indicated.

2.5.2.4 **Threaded Pipe Plugs**: ANSI B16.14.

2.5.2.5 **Flanged Cast Iron**: ANSI B16.1, including bolting.

2.5.2.6 **Steel Flanges/Fittings**: ANSI B16.5, including bolting and gasketing.

2.5.2.7 **Wrought-Steel Buttwelding Fittings**: ANSI B16.9, except ANSI B16.28 for short radius elbows and returns, rated to match connected pipe.

2.5.2.8 **Pipe Nipples**: Fabricated from same pipe as used for connected pipe; except do not use less than schedule 80 pipe where length remaining unthreaded is less than 1 ½ inches, and where pipe size is less than 1 ½ inches, and do not thread nipples full length (no close-nipples).

2.6 **Plastic Pipes and Fittings**:

230520-2 PIPES AND PIPE FITTINGS
2.6.1 Pipes:

2.6.1.1 PVC DWV Pipe: ASTM D-2665, Schedule 40.

2.6.1.2 PVC Sewer Pipe: ASTM D-3034.

2.6.2 Fittings:

2.6.2.1 PVC Solvent Cement: ASTM D-2564.

2.6.2.2 PVC DWV Socket: ASTM D-2665.

2.6.2.3 PVC Sewer Socket: ASTM D-3034.

3 EXECUTION

3.1 Installation

3.1.1 General: Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leak proof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance or replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings, not bushings. Align piping accurately at connections, within 1/16" misalignment tolerance.

3.1.2 Comply with ANSI B31 Code for Pressure Piping.

3.1.3 Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of building; limit clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation.

3.1.4 Concealed Piping: Unless specifically noted as “Exposed” on the drawings, conceal piping from view in finished and occupied spaces, by locating in column enclosures, chases, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.

3.1.5 Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical, communications, or data equipment spaces and enclosures unless shown. Install drip pan under piping that must run through electrical spaces.

3.1.5.1 Cut pipe from measurements taken at the site, not from drawings. Keep pipes free of contact with building construction and installed work.

3.2 Piping System Joints: Provide joints of the type indicated in each piping system.

3.2.1 Solder copper tube-and-fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply non-acid type solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

3.2.2 Thread pipe in accordance with ANSI B2.1; cut threads full and clean using sharp dies. Ream threaded ends to remove burrs and restore full inside diameter. Apply pipe joint compound, or pipe joint tape (Teflon) where recommended by pipe/fitting manufacturer, on male threads at each joint and tighten joint to leave not more than 3 threads exposed. Paint exposed threads to retard rusting.
3.2.3 Flanged Joints: Match flanges within piping system, and at connection with valves and equipment. Clean flange faces and install gaskets. Tighten bolts to provide uniform compression of gaskets. Bolts shall project 1/8" to 3/8" beyond nut face when tight.

3.2.4 Weld pipe joints in accordance with recognized industry practice and as follows. Be guided by ANSI B.31.

3.2.4.1 Weld pipe joints only when ambient temperature is above 0°F.

3.2.4.2 Bevel pipe ends at a 37.5° angle where possible, smooth rough cuts, and clean to remove slag, metal particles and dirt.

3.2.4.3 Use pipe clamps or tack-weld joints; 4 welds for pipe sizes to 10". All welds shall be open-butt.

3.2.4.4 Build up welds with root pass, followed by filler pass and then a cover pass. Eliminate valleys at center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes and non-metallic inclusions.

3.2.4.5 Do not weld-out piping system imperfections by tack-welding procedures; refabricate to comply with requirements.

3.2.4.6 At Installer's option, install forged branch-connection fittings wherever branch pipe is less than 3" and at least two pipe sizes smaller than main pipe indicated; or install regular "T" fitting. Weld-O-Let or equal.

3.2.4.7 All field welding and cutting using oxygen-acetylene methods within the building shall be performed in accordance with NFPA-51B (1994).

3.2.4.8 Limit the use of welded piping to shop-fabricated only. Neither welding nor cutting with oxygen-acetylene methods will be permitted within the envelope of the hospital building.

3.2.5 Plastic Pipe Joints: Comply with manufacturer's instructions and recommendations, and with applicable industry standards.

3.2.5.1 Solvent-cemented joints shall be made in accordance with ASTM D-2235 and ASTM F-402.

3.2.5.2 PVC sewer pipe bell/gasket joints shall be installed in accordance with ASTM D-2321.

3.3 Piping Installation

3.3.1 Install piping to allow for expansion and contraction.

3.3.2 Isolate all copper tubing from steel and concrete by wrapping the pipe at the contact point, and for one inch on each side, with a continuous plastic sleeve. Isolate all copper tubing installed in block walls with a continuous plastic sleeve.

3.3.3 Underground Piping:

3.3.3.1 Provide plastic tape markers over all underground piping. Provide copper wire over all underground plastic piping. Locate markers 18" above piping.

3.3.3.2 Coat the following underground (uninsulated) pipes with a heavy coat of bitumastic or provide an 8 mil polyvinyl sleeve: black steel pipe, galvanized steel pipe, copper tubing.

END OF SECTION
SECTION 20 05 21

PIPING SPECIALTIES

1 GENERAL

1.1 Drawings and general provisions of contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-23 section making reference to or requiring piping specialties specified herein.

1.3 Approval Submittals:

1.3.1 Product Data: Submit product data with installation instructions and UL listing for:

1.3.1.1 Fire barrier sealants.

2 PRODUCTS

2.1 General: Provide factory-fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service, or if not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

2.2 Escutcheons:

2.2.1 General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.

2.2.2 Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.

2.2.3 Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

2.3 Dielectric Unions Waterways: Provide standard products recommended by manufacturer Victaulic Style 47 dielectric waterways for use in service indicated, which effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action and stop corrosion. Dielectric unions are not acceptable.

2.4 Fire Barrier Penetration Seals:

2.4.1 Provide seals for any opening through fire-rated walls, floors, or ceilings used as passage for mechanical components such as piping or ductwork in accordance with the requirements of Division 7.

2.4.2 Cracks, Voids, or Holes Up to 4" Diameter: Use putty or calking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding 10 times when exposed to flame or heat, UL-listed.

2.4.3 Openings 4" or Greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E-814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250 to 350°F, UL-listed.

2.5 Fabricated Piping Specialties:
2.5.1 **Drip Pans**: Provide drip pans fabricated from corrosion-resistant sheet metal with watertight joints, and with edges turned up 2-1/2". Reinforce top, either by structural angles or by rolling top over ¼" steel rod. Provide hole, gasket, and flange at low point for watertight joint and 1" drain line connection.

2.5.2 **Pipe Sleeves**: Provide pipe sleeves of one of the following:

2.5.2.1 **Sheet-Metal**: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams, or welded longitudinal joint. Fabricate from the following gages: 3" and smaller, 20 gage; 4" to 6" 16 gage; over 6", 14 gage.

2.5.2.2 **Steel-Pipe**: Fabricate from Schedule 40 galvanized steel pipe; remove burrs.

2.5.2.3 **Iron-Pipe**: Fabricate from cast-iron or ductile-iron pipe; remove burrs.

2.5.3 **Sleeve Seals**: Provide sleeve seals for sleeves located in foundation walls below grade, or in exterior walls, of one of the following:

2.5.3.1 **Caulking and Sealant**: Provide foam or caulking and sealant compatible with piping materials used.

### EXECUTION

3.1 **Pipe Escutcheons**: Install pipe escutcheons on each pipe penetration through floors, walls, partitions, and ceilings where penetration is exposed to view; and on exterior of building. Secure escutcheon to pipe or insulation so escutcheon covers penetration hole, and is flush with adjoining surface.

3.2 **Dielectric Unions Waterways**: Install at each piping joint between ferrous and non-ferrous piping. Comply with manufacturer's installation instructions.

3.3 **Fire Barrier Penetration Seals**: Provide pipe sleeve as required. Fill entire opening with sealing compound. Adhere to manufacturer's installation instructions. Refer to Division 7.

3.4 **Drip Pans**: Locate drip pans under piping passing over or within 3' horizontally of electrical equipment, and elsewhere as indicated. Hang from structure with rods and building attachments, weld rods to sides of drip pan. Brace to prevent sagging or swaying. Connect 1" drain line to drain connection, and run to nearest plumbing drain or elsewhere as indicated.

3.5 **Pipe Sleeves**: Install pipe sleeves of types indicated where piping passes through walls, floors, ceilings, and roofs. Do not install sleeves through structural members of work, except as detailed on drawings, or as reviewed by Architect/Engineer. Install sleeves accurately centered on pipe runs. Size sleeves so that piping and insulation (if any) will have free movement in sleeve, including allowance for thermal expansion; but not less than 2 pipe sizes larger than piping run. Where insulation includes vapor-barrier jacket, provide sleeve with sufficient clearance for installation. Install length of sleeve equal to thickness of construction penetrated, and finish flush to surface; except floor sleeves. Extend floor sleeves ¼" above level floor finish, and ¾" above floor finish sloped to drain. Provide temporary support of sleeves during placement of concrete and other work around sleeves, and provide temporary closure to prevent concrete and other materials from entering sleeves.

3.5.1 Install sleeves in fire-rated assemblies in accordance with the listing of the assembly and the fire barrier sealant.

3.5.2 Install sheet-metal sleeves at interior partitions and ceilings other than suspended ceilings. Fill annular space with caulking or fire barrier sealant as required.

3.5.3 Install steel-pipe sleeves at floor penetrations. Fill annular space with caulking or fire barrier sealant as required.

3.5.4 Install iron-pipe sleeves at all foundation wall penetrations and at exterior penetrations; both above and below grade. Fill annular space with caulking or mechanical sleeve seals.

END OF SECTION
1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to the work of this section.

1.2 This section is a Division-23 Basic Materials and Methods section, and is part of each Division-23 section making reference to or requiring valves specified herein.

1.3 Extent of valves required by this section is indicated on drawings and/or specified in other Division-23 sections.

1.4 Quality Assurance:

1.4.1 Valve Dimensions: For face-to-face and end-to-end dimensions of flanged or welding-end valve bodies, comply with ANSI B16.10.

1.4.2 Valve Types: Provide valves of same type by same manufacturer.

1.5 Approval Submittals: When required by other Division-23 sections, submit product data, catalog cuts, specifications, and dimensioned drawings for each type of valve. Include pressure drop curve or chart for each type and size of valve. Submit valves with Division-23 section using the valves, not as a separate submittal. Submit valve comparison chart with applicable valves clearly marked if valves other than basis-of-design are to be used. For each valve, identify systems where the valve is intended for use.

1.5.1 Gate Valves. Type GA.

1.5.2 Check Valves. Type CK.

1.5.3 Ball Valves. Type BA.

1.6 O&M Data Submittals: Submit a copy of approval submittals. Submit installation instructions, maintenance data and spare parts lists for each type of valve. Include this data in the O&M Manual.

2 PRODUCTS

2.1 General: Provide factory-fabricated valves recommended by manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with specifications and installation requirements. Provide sizes as indicated, and connections which properly mate with pipe, tube, and equipment connections.

2.2 Acceptable Manufacturers: Subject to compliance with requirements, provide valves of one of the producers listed for each valve type. Other valve manufacturers list names are also acceptable. The model numbers are listed for contractor’s convenience only. In the case of a model number discrepancy, the written description shall govern.

2.3 Gate Valves:

2.3.1 Packing: Select valves designed for repacking under pressure when fully opened, equipped with non-asbestos packing suitable for intended service. Select valves designed so back seating protects packing and stem threads from fluid when valve is fully opened, and equipped with gland follower.

2.3.2 Comply with the following standards:


Steel Valves: ANSI B16.34. Steel Standard Class Valve Ratings.

2.3.3 Types of gate (GA) valves:


5. **Soldered Ends 2" and Smaller (GA5):** Class 150, bronze body, screwed bonnet, rising stem, solid wedge. Stockham B-124. Nibco S-134. Milwaukee 1169.

6. **Threaded Ends 2" and Smaller (GA6):** 175 WWP, bronze body, screwed bonnet, rising stem, OS&Y, solid wedge, UL-listed. Stockham B-133. Nibco T-104-0.

7. **Flanged Ends 2½" and Larger (GA7):** 175 WWP, iron body, bolted bonnet, rising stem, OS&Y, solid wedge, UL listed. Stockham G-634. Nibco F-607-0TS.


11. **Flanged Ends 2½" and Larger (GA11):** Class 300, cast steel body, bolted bonnet, rising stem, solid wedge, seal-welded seat rings. Provide trim to match use. Stockham 30-0F. Crane 33.

12. **Flanged Ends 2½" and Larger (GA12):** 300 WWP, iron body, bolted bonnet, bronze mounted, rising stem, OS&Y, solid wedge, UL-listed. Stockham F-670. Nibco F-697-0.

2.4 Check Valves:

2.4.1 Construction: Construct valves of castings free of any impregnating materials. Construct valves with a bronze regrinding disc with a seating angle of 40º to 45º, unless a composition disc is specified. Provide stop plug as renewable stop for disc hanger, unless otherwise specified. Disc and hanger shall be separate parts with disc free to rotate. Support hanger pins on both ends by removable side plugs.

2.4.2 Comply with the following standards:

- **Cast Iron Valves:** MSS SP-71. Cast Iron Swing Check Valves, Flanged and Threaded Ends.
- **Bronze Valves:** MSS SP-80. Bronze Gate, Globe, Angle and Check Valves.
- **Steel Valves:** ANSI B16.34. Steel Standard Class Valve Ratings.

2.4.3 Types of check (CK) valves:


2. **Soldered Ends 2" and Smaller (CK2):** Class 125, bronze body, screwed cap, horizontal swing, bronze disc. Stockham B-309. Nibco S-413-B. Crane 1707S. Milwaukee 1509.
Flanged Ends 2½" and Larger (CK3): Class 125, iron body, bronze-mounted, bolted cap, horizontal swing, cast-iron or composition disc. Stockham G-931 or G-932 as applicable. Nibco F918-B. Crane 373. Milwaukee F2974 as applicable.

Threaded Ends 2" and Smaller (CK4): 200 WWP, bronze body, screwed cap, horizontal swing, regrinding type bronze disc, for fire sprinkler use. Nibco KT-403-W.

Flanged Ends 2½" and Larger (CK5): 175 WWP, iron body, bolted cap, bronze mounted, composition disc, UL listed, with ball drip if required. Stockham G-940. Nibco F-908-W.


Flanged Ends 2½" and Larger (CK9): Class 300, cast steel body, bolted cap, horizontal swing, seal welded seat rings, chromium stainless disc. Stockham 30-SF. Crane 159.

2.5 Ball Valves:

2.5.1 General: Select with port area equal to or greater than connecting pipe area, include seat ring designed to hold sealing material.

2.5.2 Construction: Ball valves shall be rated for 150 psi saturated steam and 600 psi non-shock cold water. Pressure containing parts shall be constructed of ASTM B-584 alloy 844, or ASTM B-124 alloy 377. Valves shall be furnished with blow-out proof bottom loaded stem constructed of ASTM B-371 alloy 694 or other approved low zinc material. Provide TFE packing, TFE thrust washer, chrome-plated ball and reinforced teflon seats. Valves 1" and smaller shall be full port design. Valves 1¼" and larger shall be conventional port design. Stem extensions shall be furnished for use in insulated piping where insulation exceeds ½" thickness.

2.5.3 Comply with the following standards:

MSS SP-72. Ball Valves with Flanged or Butt Welding Ends for General Service.
MSS SP-110. Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

2.5.4 Types of ball (BA) valves:


3. Threaded Ends 1" and Smaller (BA3): Bronze two-piece full port body, UL listed (UL 842) for use with flammable liquids and LP gas. Nibco T-585-70-UL.

4. Threaded Ends 2" and Smaller (BA4): 175 WWP, bronze two-piece body, UL listed for fire protection service. Nibco KT-585-70-UL and KT-580-70-UL.

5. Threaded Ends 2" and Smaller (BA5): 400 WWP, bronze two-piece body, for fire protection service. Nibco KT-580.

6. Threaded Ends 2½" and Smaller (BA6): 300 WWP, bronze three-piece body, gear operator with handwheel, indicator flag, accepts tamper switch, for fire protection, UL listed. Nibco T-505-4 and
2.6 Valve Features:

2.6.1 General: Provide valves with features indicated and, where not otherwise indicated, provide proper valve features as determined by Installer for installation requirements. Comply with ANSI B31.1

2.6.2 Valve features specified or required shall comply with the following:

1. **Bypass**: Comply with MSS SP-45, and except as otherwise indicated, provide manufacturer's standard bypass piping and valving. Provide for gate valves 8" and larger.

2. **Drain**: Comply with MSS SP-45, and provide threaded pipe plugs complying with applicable Division-23 pipe or tube section. Provide for gate valves 8" and larger.

3. **Flanged**: Provide valve flanges complying with ANSI B16.1 (cast iron), ANSI B16.5 (steel), or ANSI B16.24 (bronze).


5. **Solder-Joint**: Provide valve ends complying with ANSI B16.18.

6. **Trim**: Fabricate pressure-containing components of valve, including stems (shafts) and seats from brass or bronze materials, of standard alloy recognized in valve manufacturing industry unless otherwise specified.

7. **Non-Metallic Disc**: Provide non-metallic material selected for service indicated in accordance with manufacturer's published literature.

8. **Renewable Seat**: Design seat of valve with removable disc, and assemble valve so disc can be replaced when worn.

9. **Extended Stem**: Increase stem length by 2" minimum, to accommodate insulation applied over valve.

10. **Mechanical Actuator**: Provide factory-fabricated gears, gear enclosure, external chain attachment and chain designed to provide mechanical advantage in operating valve for all valves 4" and larger that are mounted more than 7'-0" above the floor, or are otherwise difficult to operate regardless of height.

3 EXECUTION

3.1 Installation:

3.1.1 General: Install valves where required for proper operation of piping and equipment, including valves in branch lines to isolate sections of piping. Locate valves so as to be accessible and so that separate support can be provided when necessary. Install valves with stems pointed up, in vertical position where possible, but in no case with stems pointed downward below horizontal plane.

3.1.2 Insulation: Where insulation is indicated, install extended-stem valves, arranged in proper manner to receive insulation.

3.1.3 Applications Subject to Corrosion: Do not install bronze valves and valve components in direct contact with steel, unless bronze and steel are separated by dielectric insulator.

3.1.4 Mechanical Actuators: Install mechanical actuators as recommended by valve manufacturer.

3.2 Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select and install valves with
the following ends or types of pipe/tube connections:

3.2.1 **Tube Size 2" and Smaller**: Threaded valves. Soldered-joint valves may also be used.

3.2.2 **Pipe Size 2" and Smaller**: Threaded valves.

3.2.3 **Pipe Size 2½" and Larger**: Flanged valves.

3.3 **Non-Metallic Disc**: Limit selection and installation of valves with non-metallic disc to locations indicated and where foreign material in piping system can be expected to prevent tight shutoff of metal seated valves.

3.4 **Renewable Seats**: Select and install valves with renewable seats, except where otherwise indicated.

3.5 **Installation of Check Valves**: Install in horizontal position with hinge pin horizontally perpendicular to center line of pipe. Install for proper direction flow.

END OF SECTION
SECTION 23 05 29
SUPPORTS, ANCHORS, AND SEALS

1  GENERAL

1.1 Drawings and general provisions of Contract, including General Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 This section is a Division-23 Basic Materials and Methods section, and is a part of each Division-23 section making reference to or requiring supports, anchors, and seals specified herein.

1.3 Extent of supports, anchors, and seals required by this section is indicated on drawings and/or specified in other Division-23 sections.

1.4 Code Compliance: Comply with applicable codes pertaining to product materials and installation of supports, anchors, and seals.

1.5 MSS Standard Compliance:

1.5.1 Provide pipe hangers and supports of which materials, design, and manufacture comply with ANSI/MSS SP-58.

1.5.2 Select and apply pipe hangers and supports, complying with MSS SP-69.

1.5.3 Fabricate and install pipe hangers and supports, complying with MSS SP-89.

1.5.4 Terminology used in this section is defined in MSS SP-90.

1.6 UL and FM Compliance: Provide products which are Underwriters Laboratories listed and Factory Mutual approved.

2  PRODUCTS

2.1 Acceptable Manufacturers: Subject to compliance with requirements, provide supports and hangers by Grinnel, Michigan Hanger Company, B-Line Systems, or approved equal.

2.2 Horizontal-Piping Hangers and Supports: Except as otherwise indicated, provide factory-fabricated horizontal-piping hangers and supports complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

2.2.1 Adjustable Steel Clevises: MSS Type 1.

2.2.2 Steel Double Bolt Pipe Clamps: MSS Type 3.

2.2.3 Adjustable Steel Band Hangers: MSS Type 7.

2.2.4 Steel Pipe Clamps: MSS Type 4.

2.2.5 Pipe Stanchion Saddles: MSS Type 37, including steel pipe base support and cast-iron floor flange.

2.2.6 Single Pipe Rolls: MSS Type 41.

2.2.7 Adjustable Roller Hanger: MSS Type 43.

2.2.8 Pipe Roll Stands: MSS Type 44 or Type 47.
Vertical-Piping Clamps: Except as otherwise indicated, provide factory-fabricated vertical-piping clamps complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit vertical piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Select size of vertical piping clamps to exactly fit pipe size of bare pipe. Provide copper-plated clamps for copper-piping systems.

2.3.1 Two-Bolt Riser Clamps: MSS Type 8.

2.3.2 Four-Bolt Riser Clamps: MSS Type 42.

Hanger-Rod Attachments: Except as otherwise indicated, provide factory-fabricated hanger-rod attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit horizontal-piping hangers and building attachments, in accordance with MSS SP-69 and manufacturer's published product information. Use only one type by one manufacturer for each piping service. Select size of hanger-rod attachments to suit hanger rods. Provide copper-plated hanger-rod attachments for copper-piping systems.

2.4.1 Steel Turnbuckles: MSS Type 13.

2.4.2 Malleable Iron Sockets: MSS Type 16.

Building Attachments: Except as otherwise indicated, provide factory-fabricated building attachments complying with ANSI/MSS SP-58, of one of the following MSS types listed, selected by Installer to suit building substrate conditions, in accordance with MSS SP-69 and manufacturer's published product information. Select size of building attachments to suit hanger rods.

2.5.1 Center Beam Clamps: MSS Type 21.

2.5.2 C-Clamps: MSS Type 23.

2.5.3 Malleable Beam Clamps: MSS Type 30.

2.5.4 Side Beam Brackets: MSS Type 34.

2.5.5 Concrete Inserts: MSS Type 18.

Saddles and Shields: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.

2.6.1 Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.

2.6.2 Protection Saddles: MSS Type 39; use with rollers, fill interior voids with segments of insulation matching adjoining insulation.

Miscellaneous Materials:

2.7.1 Metal Framing: Provide products complying with NEMA STD ML 1.

2.7.2 Steel Plates, Shapes and Bars: Provide products complying with ANSI/ASTM A 36.

2.7.3 Cement Grout: Portland cement (ANSI/ASTM C 150, Type I or Type III) and clean uniformly graded, natural sand (ANSI/ASTM C 404, Size No. 2). Mix at a ratio of 1.0 part cement to 3.0 parts sand, by volume, with minimum amount of water required for placement and hydration.

2.7.4 Heavy-Duty Steel Trapezes: Fabricate from steel shapes or continuous channel struts selected for loads required; weld steel in accordance with AWS standards.
EXECUTION

3 Preparation

3.1 Proceed with installation of hangers, supports and anchors only after required building structural work has been completed in areas where the work is to be installed. Correct inadequacies including (but not limited to) proper placement of inserts, anchors and other building structural attachments.

3.1.2 Prior to installation of hangers, supports, anchors and associated work, Installer shall meet at project site with Contractor, installer of each component of associated work, and installers of other work requiring coordination with work of this section for purpose of reviewing material selections and procedures to be followed in performing the work in compliance with requirements specified.

3.2 Installation of Building Attachments:

3.2.1 Install building attachments at required locations within concrete or on structural steel for proper piping support. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional building attachments where support is required for additional concentrated loads, including valves, flanges, guides, strainers, expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten insert securely to forms. Where concrete with compressive strength less than 2500 psi is indicated, install reinforcing bars through openings at top of inserts.

3.2.2 In areas of work requiring attachments to existing concrete, use self drilling rod inserts, Phillips Drill Co., "Red-Head" or equal.

3.3 Installation of Hangers and Supports:

3.3.1 General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69 or as listed herein, whichever is most limiting. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping.

3.3.1.1 Horizontal steel pipe and copper tube 1-1/4" diameter and smaller: support on 6 foot centers.

3.3.1.2 Horizontal steel pipe and copper tube 1-1/2" diameter and larger: support on 10 foot centers.

3.3.1.3 Vertical steel pipe and copper tube: support at each floor.

3.3.1.4 Plastic pipe: support in accordance with manufacturer's recommendations.

3.3.1.5 Horizontal cast iron pipe inside building: support each length of pipe (at the joint).

3.3.1.6 Vertical cast iron pipe: support at each floor and at the base.

3.3.1.7 Fire protection piping: support in accordance with NFPA 13.

3.3.2 Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories.

3.3.3 Paint all black steel hangers with black enamel. Galvanized steel and copper clad hangers do not require paint.

3.3.4 Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

3.3.5 Provision for Movement:
3.3.5.1 Install hangers and supports to allow controlled movement of piping systems and to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends and similar units.

3.3.5.2 Load Distribution: Install hangers and supports so that piping live and dead loading and stresses from movement will not be transmitted to connected equipment.

3.3.5.3 Pipe Slopes: Install hangers and supports to provide indicated pipe slopes, and so that maximum pipe deflections allowed by ANSI B31 are not exceeded.

3.3.6 Insulated Piping: Comply with the following installation requirements.

3.3.6.1 Shields: Where low-compressive-strength insulation or vapor barriers are indicated, install coated protective shields. For pipe 8" and over, install wood insulation saddles.

3.3.6.2 Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation; do not exceed pipe stresses allowed by ANSI B31.

3.3.7 Support fire protection piping independently of other piping.

3.4 Installation of Anchors:

3.4.1 Install anchors at proper locations to prevent stresses from exceeding those permitted by ANSI B31, and to prevent transfer of loading and stresses to connected equipment.

3.4.2 Fabricate and install anchors by welding steel shapes, plates and bars to piping and to structure. Comply with ANSI B31 and with AWS standards.

3.4.3 Anchor Spacings: Where not otherwise indicated, install anchors at ends of principal pipe-runs, at intermediate points in pipe-runs between expansion loops and elbows. Make provisions for preset of anchors as required to accommodate both expansion and contraction of piping.

3.4.4 Where expansion compensators are indicated, install anchors in accordance with expansion unit manufacturer's written instructions to limit movement of piping and forces to maximums recommended by manufacturer for each unit.

3.5 Equipment Bases:

3.5.1 Concrete housekeeping bases will be provided as work of Division 3. Furnish to Contractor scaled layouts of all required bases, with dimensions of base, and location to column center lines. Furnish templates, anchor bolts, and accessories necessary for base construction.

4.6.1 Provide concrete housekeeping bases for all floor mounted equipment furnished as part of the work of Division 23. Size bases to extend minimum of 4" beyond equipment base in any direction; and 4" above finished floor elevation. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.

4.6.2 Provide structural steel stands to support equipment not floor mounted or hung from structure. Construct of structural steel members or steel pipe and fittings. Provide factory-fabricated tank saddles for tanks mounted on steel stands. Prime and paint with black enamel.

END OF SECTION 23 05 29
1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-23 section making reference to vibration isolation equipment.

1.3 Extent of vibration isolation required by this section is indicated on drawings and/or specified in other Division-23 sections.

1.4 Approval Submittals: When required by other Division-23 sections, submit product data sheets for each type of vibration isolation equipment including configuration and rating data. Submit with Division-23 section using vibration isolation, not as a separate submittal. Provide calculations showing supported weight, deflection, and isolator size and type for each item of supported equipment. Submit for:

1.4.1 Equipment Mountings. Type EM.

1.4.2 Hangers. Type HA.

1.5 O&M Data Submittals: Submit a copy of approval submittals for each type of vibration isolation equipment. Include this data in O&M Manual.

2 PRODUCTS

2.1 General: Provide factory-fabricated products recommended by manufacturer for use in service indicated. Provide products of types and deflections indicated; provide proper selection as determined by Installer to comply with specifications and installation requirements. Provide sizes which properly fit with equipment. All metal parts installed outside shall be hot dipped galvanized after fabrication.

2.2 Acceptable Manufacturers: Subject to compliance with requirements, provide vibration isolation equipment of: Mason Industries, Keflex, Consolidated Kinetics, Vibration Mountings & Controls, Wheatley or approved equal. All vibration isolators shall be supplied by a single approved manufacturer.

2.3 Equipment Mountings:

2.3.1 Select mountings with the required deflection and fastening means. Provide steel rails or bases as required to compensate for equipment rigidity and overhang.

2.3.2 Types of equipment mountings (EM):

1 Spring Mountings (EM1): Spring isolators shall be free-standing and laterally stable without any housing. All mounts shall have leveling bolts. Spring diameter shall be not less than 0.8 of the compressed height of the spring at rated load. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Springs shall be so designed that the ratio of horizontal stiffness to vertical stiffness is approximately one. Provide a nominal static deflection of at least 1.0". Basis of Design: Mason Industries SLFH.

2 Spring Mountings with Housings (EM2): Spring isolators shall consist of open, stable steel springs and include vertical travel limit stops to control extension when weight is removed. The housing of the spring unit shall serve as blocking during erection of equipment. Provide a nominal static deflection of at least 1.0". All mountings used outside shall be hot dipped galvanized. Basis of Design: Mason Industries SLR.
3 **Spring Mountings with Housings (EM3):** Spring isolators shall consist of open, stable steel springs with neoprene inserts to limit movement between upper and lower housing on start and stop. Provide a nominal static deflection of at least 1.0”. Mountings shall be specifically designed for critical areas on light-weight floors. Basis of Design: Mason Industries C.

4 **Neoprene Mountings (EM4):** Double deflection neoprene-in-shear mountings shall have a minimum static deflection of 0.35”. All metal surfaces shall be neoprene covered. The top and bottom surfaces shall be neoprene ribbed and bolt holes shall be provided in the base. Basis of design: Mason Industries ND.

5 **Pads (EM5):** Waffle or ribbed pattern neoprene pads shall be fabricated from 40-50 durometer neoprene. Provide rigid steel plate and mounting angles as required. Basis of design: Mason Industries Super W.

2.4 **Hangers:**

2.4.1 **Select** hangers with the required deflection. Provide all required hanger rods and fasteners.

2.4.2 **Types** of hangers (HA):

1 **Hangers (HA1):** Vibration hangers shall contain a steel spring set in a neoprene cup manufactured with a grommet to prevent short-circuiting of the hanger rod. The cup shall contain a steel washer designed to properly distribute the load on the neoprene and prevent its extrusion. Spring diameters and hanger box lower-hole sizes shall be large enough to permit the hanger rod to swing through a 30-degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Basis of Design: Mason Industries 30.

2 **Hangers (HA2):** Vibration hangers shall contain a laterally stable steel spring and 0.3" deflection neoprene or fiberglass element in series. A neoprene neck shall be provided where the hanger rod passes through the steel box supporting the isolator mount to prevent metal to metal contact. Spring diameters and hanger box lower hole sizes shall be large enough to permit the hanger rod to swing through a 30 degree arc before contacting the hole and short circuiting the spring. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection. Basis of Design: Mason Industries 30N.

3 **Hangers (HA3):** Double deflection neoprene-in-shear or EPDM hangers. Units shall be complete with projected neoprene bushing to prevent steel-to-steel contact between hanger box and hanger rod. Average static deflection shall be not less than 0.4 inches. Basis of Design: Mason Industries HD.

3 **EXECUTION**

3.1 Install vibration isolation devices for the duty indicated and for ease of inspection, adjustment, and proper operation. Install in accordance with the manufacturer’s written instructions and coordinate with shop drawings of supported equipment.

3.2 All connections to fixtures and equipment shown on the drawings shall be considered diagrammatic unless otherwise indicated by detail. The actual connections shall be made to fully suit the requirements of each case and adequately provide for expansion and servicing.

3.3 Piping, ductwork and conduit shall not be suspended from one another or physically contact one another. Vibrating systems shall be kept free from non-vibrating systems.

3.4 **Equipment Mountings:**

3.4.1 Unless otherwise shown or specified, all floor-mounted equipment shall be set on housekeeping equipment bases. Refer to Division-23 section “Supports, Anchors, and Seals”.

3.4.2 No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to
span between isolators, and such direct support is approved by the equipment manufacturer. All support frames shall be sufficiently stiff and rigid so as to prevent distortion and misalignment of components installed thereon.

3.4.3 Align equipment mountings for a free, plumb installation. Isolators that are binding, offset or fully compressed will not be accepted.

3.5 Hangers:

3.5.1 Position vibration isolation hangers so that hanger housing may rotate a full 360 degrees without contacting any object.

3.5.2 Install steel angles, channels, rods and fasteners to level equipment, piping or ductwork and to evenly distribute the supported weight.

3.6 Connections of Ducts: Ducts shall be connected to fan intakes and discharges by means of flexible connectors in accordance with Division-23 section "Ductwork Accessories" so that all vibrating equipment is fully isolated.

END OF SECTION 23 05 48
GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-23 section making reference to or requiring identification devices specified herein.

1.3 Extent of mechanical identification work required by this section is indicated on drawings and/or specified in other Division-23 sections.

1.4 Refer to Division-26 sections for identification requirements of electrical work; not work of this section. Refer to other Division-23 sections for identification requirements for controls; not work of this section.

1.5 Codes and Standards: Comply with ANSI A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

PRODUCTS

2.1 General: Provide manufacturer's standard products of categories and types required for each application as referenced in other Division-23 sections. Where more than single type is specified for application, selection is Installer's option, but provide single selection for each product category.

2.2 Painted Identification Materials

2.2.1 Stencils: Standard fiberboard stencils, prepared for required applications with letter sizes generally complying with recommendations of ANSI A13.1 for piping and similar applications, but not less than 1-¼" high letters for ductwork and not less than ¾" high letters for access door signs and similar operational instructions.

2.2.2 Stencil Paint: Standard exterior type stenciling enamel; black, except as otherwise indicated; either brushing grade or pressurized spray-can form and grade.

2.2.3 Identification Paint: Standard identification enamel.

2.3 Plastic Pipe Markers

2.3.1 Pressure-Sensitive Type: Provide manufacturer's standard pre-printed, permanent adhesive, color-coded, pressure-sensitive vinyl pipe markers.

2.3.1.1 Lettering: Manufacturer's standard pre-printed nomenclature which best describes piping system in each instance, as selected by Architect/Engineer in cases of variance with name as shown or specified.

2.3.1.2 Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

2.4 Valve Tags:

2.4.1 Brass Valve Tags: Provide 19-gage polished brass valve tags with stamp-engraved piping system abbreviation in ¼" high letters and sequenced valve numbers ½" high, and with 5/32" hole for fastener. Provide 1-½" diameter tags, except as otherwise indicated.

2.4.2 Plastic Laminate Valve Tags: Provide manufacturer's standard 3/32" thick engraved plastic laminate valve tags, with piping system abbreviation in ¼" high letters and sequenced valve numbers ½" high,
and with 5/32" hole for fastener. Provide 1-½" square black tags with white lettering, except as otherwise indicated.

2.5 Engraved Plastic-Laminate Signs:

2.5.1 General: Provide engraving stock melamine plastic laminate, in the sizes and thicknesses indicated, engraved with engraver’s standard letter style a minimum of 3/4” tall and wording indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

2.5.2 Thickness: 1/16” for units up to 20 sq. in. or 8” length; 1/8” for larger units.

2.5.3 Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate the substrate.

2.6 Stamped Nameplates: Provide equipment manufacturer's standard stamped nameplates for motors, AHUs, pumps, etc.

3 EXECUTION

3.1 Coordination: Where identification is to be applied to surfaces which require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.

3.2 Ductwork Identification:

3.2.1 General: Identify air supply, return, exhaust, intake and relief ductwork with stenciled signs and arrows, showing ductwork service and direction of flow, in black or white.

3.2.2 Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures, and at 50’ spacings along exposed runs.

3.2.3 Access Doors: Provide stenciled signs on each access door in ductwork and housings, indicating purpose of access (to what equipment) and other maintenance and operating instructions, and appropriate and procedural information.

3.3 Piping System Identification:

3.3.1 General: Install pipe markers of one of the following types on each system indicated to receive identification, and include arrows to show normal direction of flow:

3.3.1.1 Plastic pipe markers.

3.3.1.2 Stenciled markers, black or white for best contrast.

3.3.2 Locate pipe markers as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces and exterior non-concealed locations.

3.3.2.1 Near each valve and control device.

3.3.2.2 Near each branch, excluding short take-offs for fixtures and terminal units; mark each pipe at branch, where there could be question of flow pattern.

3.3.2.3 Near locations where pipes pass through walls, floors, ceilings, or enter non-accessible enclosures.

3.3.2.4 At access doors, manholes and similar access points which permit view of concealed piping.

3.3.2.5 Near major equipment items and other points of origination and termination.
3.3.2.6 Spaced intermediate at maximum spacing of 50' along each piping run, except reduce spacing to 25' in congested areas of piping and equipment.

3.3.2.7 On piping above removable acoustical ceilings, except omit intermediate spaced markers.

3.3.3 The following piping shall be color-coded where exposed in mechanical and electrical rooms by completely painting the piping with the indicated color. Use standard colors where exposed in finished spaces. Use standard identification methods in concealed areas.

Gas piping - Yellow

3.4 Valve Identification: Provide coded valve tag on every valve, cock and control device in each piping system; exclude check valves, valves within factory-fabricated equipment units, plumbing fixture faucets, convenience and lawn-watering hose bibs, and shut-off valves at plumbing fixtures, HVAC terminal devices and similar rough-in connections of end-use fixtures and units. Coordinate code with operating instructions.

3.5 Valve Charts: Provide framed, glass covered valve charts in each mechanical room. Identify coded valve number, valve function, and valve location for each valve.

3.6 Mechanical Equipment Identification: Install engraved plastic laminate sign on a vertical surface on or near each major item of mechanical equipment and each operational device. Label shall indicate type of system and area served. Provide signs for the following general categories of equipment and operational devices:

3.6.1 Main control and operating valves, including safety devices.

3.6.2 Meters, gauges, thermometers and similar units.

3.6.3 Water heaters, furnaces, and heaters

3.6.4 Pumps

3.6.5 HVAC air handlers and fan coil units.

3.6.6 Tanks and pressure vessels.

3.6.7 Air conditioning indoor and outdoor units.

3.7 Stamped Nameplates: Equipment manufacturers to provide standard stamped nameplates on all major equipment items such as motors, pumps, AHUs, etc. Where motors are hidden from view (within equipment casing, or otherwise not easily accessible, etc.), the equipment supplier shall furnish a duplicate motor data nameplate to be affixed to the equipment casing in an easily visible location, unless data is already included on the equipment nameplate.

3.8 Adjusting and Cleaning:

3.8.1 Adjusting: Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.

3.8.2 Cleaning: Clean face of identification devices, and glass frames of valve charts.

END OF SECTION 23 05 53
SECTION 23 05 56
ACCESS DOORS

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-23 section making reference to or requiring access panels specified herein.

1.3 Approval Submittals:

1.3.1 Product Data: When required by other Division-23 sections, submit product data for access doors. Submit with Division-23 section using access doors, not as a separate submittal. Include rating data.

1.4 O&M Data Submittals: Submit a copy of approval submittal. Include this data in O&M Manuals.

2 PRODUCTS

2.1 Acceptable Manufacturers: Subject to compliance with requirements, provide access doors by Acudor, Milcor, Jay R. Smith, Zurn, BOICO, Elmdor, or approved equal.

2.2 General: Where floors, walls and ceilings must be penetrated for access to mechanical work, provide types of access doors indicated. Furnish sizes indicated or, where not otherwise indicated, furnish adequate size for intended and necessary access. Furnish manufacturer's complete units, of type recommended for application in indicated substrate construction, in each case, complete with anchorages and hardware.

2.3 Access Door Construction: Except as otherwise indicated, fabricate wall/ceiling door units of welded steel construction with welds ground smooth; 16-gauge frames and 14-gauge flush panel doors; 175° swing with concealed spring hinges; flush screw-driver-operated cam locks; factory-applied rust-inhibitive prime-coat paint finish.

3 EXECUTION

3.1 Access doors shall be installed to operate and service all mechanical equipment including valves, dampers, duct access panels, and other items requiring maintenance that are concealed above or behind finished construction. Access doors shall be installed in walls, chase and floors as necessary, but are not required in accessible suspended ceiling systems. Access doors shall have factory applied protective phosphate coating and baked enamel primer suitable for field painting.

3.2 Access doors shall be installed by the Division installing the substrate construction. However, responsibility for furnishing and determining location of access doors is part of this Division's work. The style of access door shall be suitable for construction into which installed.

3.3 Access doors shall be sized and located as required to provide proper maintenance and service access in accordance with the manufacturer's recommendations and code authority requirements for all devices and equipment.
SECTION 230590
START-UP REQUIREMENTS FOR HEATING, VENTILATING, & AIR CONDITIONING (HVAC) SYSTEMS

1 GENERAL

1.1 Intent: It is the intent of this section to require that the startup requirements and report noted herein be performed prior to starting TAB work on each system. Work can be phased with permission of the Engineer.

1.2 Coordination:

1.2.1 The Contractor shall furnish to the TAB Contractor a complete set of plans, specifications, addenda, shop drawings, equipment performance data sheets, change orders, etc. as requested by the TAB Contractor.

1.2.2 The Contractor shall participate in a TAB coordination meeting to discuss interface requirements with the TAB Contractor and to establish a schedule for TAB work prior to start of TAB work.

1.3 Test Reports and Verification Submittals:

1.3.1 Submit Startup Report as described herein for each system. Attach Factory Startup Report for equipment as required by other Division-23 sections.

2 PRODUCTS: None

3 EXECUTION:

3.1 The TAB work shall not commence until the Engineer has received written notice from the Contractor that HVAC systems are 100% complete and are fully operational. Submit Startup Report as described herein.

3.2 The Contractor shall place all HVAC systems and equipment into complete operation during each working day of TAB work.

3.3 The Contractor shall provide access to HVAC systems and equipment by supplying ladders and/or scaffolding, and opening access panels and equipment room doors.

3.4 The TAB Contractor will provide to the Contractor TAB punch lists of non-complying HVAC work as they are discovered. The Contractor shall replace or repair non-complying work as soon as possible in order not to delay completion of TAB work.

3.5 Airside Systems: The Contractor shall provide the following information to the Engineer to substantiate proper start-up and preliminary adjustments of air handler units, belt driven fans, and duct systems.

3.5.1 Verify that air grilles (supply, return, exhaust, transfer, outdoor, etc.) are installed and connected to the duct system.

3.5.2 Verify that duct systems are clean of debris.

3.5.3 Verify that ducts attached with flexible connectors are aligned within ½" and have a uniform gap between ducts of 1"-1.5". Flexible connectors shall not leak and shall be insulated.

3.5.4 Verify that filters are clean and filter spacers are installed.

3.5.5 Verify that balancing dampers at grilles and branch ducts are operational and are fully opened.

3.5.6 Verify that fire and smoke dampers are correctly installed and are fully opened.
3.5.7 Verify that fan discharges are appropriate for the outlet ductwork with regards to the "system effect" per AMCA Publication 201. Inappropriate fan discharges will not be accepted.

3.5.8 Verify proper fan rotation.

3.5.9 Verify proper belt drive alignment.

3.5.10 Verify fan motor overload elements are correctly sized.

3.5.11 Adjust fan sheave until CFM is at or above design CFM. Provide additional sheaves and belts as required. Verify that motor is not overloaded.

3.5.12 Verify that HVAC control systems are fully operational.

3.6 **VAV Systems:** The Contractor shall provide the following information to the Engineer to substantiate the proper start-up and preliminary adjustments of variable air volume boxes and control systems.

3.6.1 Verify that the inlet duct to the box is straight for a minimum of five (5) inlet duct diameters.

3.6.2 Verify that the discharge duct from the box has no branch takeoffs within five (5) feet of the box discharge.

3.6.3 Set the box thermostat to 85°F. Verify that the box modulates to minimum cooling, and the heating activates.

3.6.4 Set the box thermostat to 55°F. Verify that the reverse operation occurs and the box modulates to maximum cooling.

3.6.5 Set box thermostat to 75°F. Deadband shall not exceed 2°F.

3.6.6 Set minimum and maximum CFM based on manufacturer’s calibration curves.

3.6.7 Verify that the static pressure probe is located 75% of the distance down the longest duct run. Mark the location of the probe on the as-builts and notify the TAB Contractor of same.

3.6.8 Verify that the static pressure control properly modulates the AHU fan’s variable frequency drive. Set static pressure controller to maintain 1 in. w.g. as the initial setting.

3.6.9 Verify that the supply air temperature controller properly modulates the chilled water control valve. Set controller to maintain 55°F. Verify that all heating coil control valves are properly modulated.

3.7 **Startup Report:** The Contractor shall submit the startup information required by this section to the Engineer in a typed report organized as outlined herein. The Startup Report is required to meet the written notice described herein prior to starting TAB work. TAB work will not start until the Startup Report has been submitted and approved.

END OF SECTION
SECTION 230591

TESTING, CLEANING, AND STERILIZATION OF PIPING SYSTEMS

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 This section is a Division-23 Basic Mechanical Materials and Methods section, and is part of each Division-23 section making reference to or requiring the testing and other procedures specified herein.

1.3 Notify the Architect/Engineer when system tests are ready to be witnessed at least 24 hours prior to the test.

1.4 All materials, test equipment, and devices required for cleaning, testing, sterilizing or purging shall be provided by the Contractor.

2 PRESSURE TESTS

2.1 General: Provide temporary equipment for testing, including pump and gauges. Test piping systems before insulation is installed wherever feasible, and remove control devices before testing. Test each natural section of each piping system independently but do not use piping system valves to isolate sections where test pressure exceeds valve pressure rating. Fill each section with indicated medium and pressurize for indicated pressure and time.

2.2 Required test period is four hours.

2.3 No piping, fixtures, or equipment shall be concealed or covered until they have been tested. The contractor shall apply each test and ensure that it is satisfactory for the period specified before calling the Architect/Engineer to observe the test. Test shall be repeated upon request to the satisfaction of those making the inspection.

2.4 Observe each test section for leakage at the end of the test period. Test fails if leakage is observed or if pressure drop exceeds 5% of the test pressure.

2.5 Check of systems during application of test pressures should include visual check for water leakage and soap bubble or similar check for air and nitrogen leakage.

2.6 During heating and cooling cycles, linear expansion shall be checked at all elbows and expansion joints for proper clearance.

2.7 Repair piping systems sections which fail required piping test. Disassemble and re-install using new materials to extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.

2.8 Pressure Test Requirements:

2.8.1 Soil, Waste, and Vent: Test all piping within the building with a 10 foot head of water. Test piping in sections so that all joints are tested. Provide test tees as required.

2.8.2 Domestic Water: Perform hydrostatic test on all piping within the building at twice the normal static pressure at service point, but not less than 100 psig. Once tested, flush out piping and leave under pressure of the supply main or 40 psig for the balance of the construction period.

3 CLEANING AND STERILIZATION
3.1 **General:** Clean exterior surfaces of installed piping systems of superfluous materials, and prepare for application of specified coatings (if any). Flush out piping systems with clean water or blowdown with air before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.

3.2 Flush and drain all water systems at least three times. Reverse flush systems from smallest piping to largest piping. Replace startup strainers with operating strainers.

3.3 **Sterilization of Domestic Water Systems:**

3.3.1 **Prerequisites:** All new hot and cold water piping installed (complete), all fixtures connected, system flushed out, and system filled with water.

3.3.2 The shut off valve at the point of connection shall be closed, all fixture outlets opened slightly, and a sterilizing solution shall be introduced at a manifold connection installed by the Contractor at the point of connection.

3.3.3 The solution shall contain 50 parts per million of available chlorine. The chlorinating material shall be either liquid chlorine or calcium hypochlorite. The solution shall be allowed to stand in the system for at least eight hours after which the entire system shall be flushed.

3.3.4 After final flushing, all aerators shall be removed, cleaned, and reinstalled. After final flush the residual chlorine shall not exceed 0.2 parts per million.

3.3.5 The Architect/Engineer shall be notified 24 hours prior to the procedure so that it can be witnessed.

3.3.6 Provide sampling and certified report by an independent testing lab. Provide written Health Department approval of disinfection samples.

END OF SECTION
SECTION 23 05 93
TESTING AND BALANCING OF MECHANICAL SYSTEMS

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section. Division-23 Basic Mechanical Materials Sections apply to work of this section.

1.2 The work of this section is intended to be performed by a test and balance contractor under a separate, stand-alone contract.

1.3 Description of Work:

1.3.1 Extent of testing, adjusting, and balancing work (TAB) is indicated by requirements of this section, and also by drawings and schedules, and is defined to include, but is not necessarily limited to, air distribution systems, hydronic distribution systems and associated equipment and apparatus of mechanical work. The work consists of setting speed and volume (flow) adjusting facilities provided for systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to work as required.

1.3.2 Pretesting: Where required by the drawings or other Division 23 sections, pretest existing HVAC systems as directed and report findings prior to start of demolition work or any other modifications to the existing systems. Results of pretesting shall be reported to the Engineer in a timely manner. Comply with standards for final TAB reports described herein.

1.3.3 Coordination: Coordinate with the General Contractor and Mechanical Contractor responsible for the HVAC system installation as required to complete the TAB work.

1.4 The intent of this specification is to balance HVAC systems within the tolerances listed, maintaining the pressure relationships indicated, with a minimum of noise.

1.4.1 Airflow Tolerances:

1.4.1.1 Air Handling: The supply air, return air and outdoor air quantities shall be balanced within ±5% of design values.

1.4.1.2 Exhaust Fans: The exhaust fan quantities shall be set as required to maintain the design exhaust terminal flows within ±5% of design values. If no exhaust terminals exist, exhaust fan air quantities shall be balanced within ±10% of design values.

1.4.1.3 Terminal Units: The air quantities associated with VAV boxes, fan coil units, self-regulating air valves, unit heaters and other similar devices shall be balanced within ±5% of design values.

1.4.1.4 Ceiling Diffusers, Supply Registers, Return and Exhaust Inlets: Balance to an air quantity within ±10% of the design values.

1.4.2 Temperature Tolerances:

1.4.2.1 Air Handling Temperatures: The controlled temperatures at AHUs shall be verified to be under control within 1°F of design values.

1.4.2.2 Room Temperatures: Balance systems and controls within ±2°F of indicated settings.

1.4.3 Pressure Relationships: Where code or design indicates a specific pressure relationship, the pressure relationship shall take precedence over airflow tolerances. Airflow tolerances may need to be held tighter than allowed tolerances to meet pressure relationships. Demonstrate the existence of positive or negative pressure to Engineer and authority having jurisdiction by making direct measurements of room relative pressure and/or flow direction.
1.5 Quality Assurance: The TAB Contractor shall be certified as follows:

1.5.1 Tester: A firm certified by National Environmental Balancing Bureau (NEBB) in those testing and balancing disciplines required for this project, who is not the Installer of the systems to be tested and is otherwise independent of the project. Comply with NEBB’s “Procedural Standards for Testing, Adjusting and Balancing of Environmental Systems” as applicable to this work.

1.5.2 Tester: A firm certified by Associated Air Balance Council (AABC) in those testing and balancing disciplines required for this project. AABC-certified firms are independent by definition. Comply with AABC's Manual MN-1 "AABC National Standards", as applicable to this work.

1.5.3 Industry Standards: Comply with American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE) recommendations pertaining to measurements, instruments and testing, adjusting and balancing, except as otherwise indicated.

1.6 Job Conditions:

1.6.1 Do not proceed with testing, adjusting, and balancing work until HVAC work (including Controls) has been completed and is operable. Ensure that there is no residual work still to be completed.

1.6.2 Do not proceed until work scheduled for testing, adjusting, and balancing is clean and free from debris, dirt and discarded building materials.

1.6.3 Do not proceed until architectural work that would affect balancing (walls, ceiling, windows, doors) have been installed.

1.6.4 Testing may proceed system by system, but each HVAC system must be complete as describe herein.

1.6.5 The mechanical contractor shall make any changes in pulleys, belts, and dampers, and/or add dampers as required for correct balancing.

1.7 Approval Submittals

1.7.1 Submit the name of the proposed test and balance company for the Engineer's approval within thirty (30) days after awarding of contract.

1.8 Test Reports and Verification Submittals:

1.8.1 Submit four (4) copies of the dated test and balance report upon completion of TAB work. The report shall include a list of instruments used for the work. The report shall be signed by the supervisor who performed the TAB work. The report shall be certified by a professional engineer (registered in Florida) who is a regular employee of the TAB company.

2 PRODUCTS

2.1 Patching Materials: Except as otherwise indicated, use same products as used by original Installer for patching holes in insulation, ductwork and housings which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes.

2.2 Test Instruments: Utilize test instruments and equipment of the type, precision, and capacity as recommended in the referenced standard. All instruments shall be in good condition and shall have been calibrated within the previous six (6) months (or more recently if required by standard).

3 EXECUTION

3.1 General:

3.1.1 Examine installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable. Do not proceed with TAB work until unsatisfactory conditions
have been corrected in manner acceptable to Tester.

3.1.2 **Test, adjust and balance** environmental systems and components, as indicated, in accordance with procedures outlined in applicable standards, and as modified or detailed herein.

3.1.3 **Test, adjust and balance** systems during summer season for air conditioning systems and during winter season for heating systems, including at least a period of operation at outside conditions within 5°F wet bulb temperature of maximum summer design condition, and within 10°F dry bulb temperature of minimum winter design condition. When seasonal operation does not permit measuring final temperatures, then take final temperature readings when seasonal operation does permit. The Contractor shall return for a change of seasons test at no additional cost to the Owner and submit the revised TAB report.

3.1.4 **Punch List:** Prepare a deficiency (punch) list for the Contractor with a copy of the Engineer that lists all items that are incorrectly installed or are functioning improperly. Provide a retest after all items are corrected.

3.1.5 **Prepare TAB report of test results,** including instrumentation calibration reports, in format recommended by applicable standards, modified as required to include all data listed herein.

3.1.6 **Patch holes** in insulation, ductwork and housings, which have been cut or drilled for test purposes, in manner recommended by original Installer.

3.1.7 **Mark equipment settings,** including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings at completion of TAB work. Provide markings with paint or other suitable permanent identification materials.

3.1.8 **Include in the TAB report recommendations** for correcting unsatisfactory mechanical performances when system cannot be successfully balanced.

3.1.9 **Include an extended warranty** of ninety (90) days after completion of test and balance work, during which time the Engineer, at his discretion, may request a recheck, or resetting of any component as listed in test report. The TAB company shall provide technicians and instruments and make any tests required by the Engineer during this time period.

3.2 **Controls**

3.2.1 Check all HVAC controls for proper location, calibration and sequence of operation.

3.2.2 Check operation of all controllers and controlled devices to verify proper action and direction. Check the operation of all interlocks.

3.2.3 Check all motorized face and bypass zone damper motors for leakage when in closed position. If leakage is more than 5%, mechanical contractor shall reset damper linkages.

3.2.4 Check all control valves for complete closure and correct action under all operating conditions.

3.2.5 Check all labs supply and exhaust system controls. Check setback functions.

3.3 **Air Balancing**

3.3.1 Leakage tests on ductwork must have been completed before air balancing.

3.3.2 Set dampers, volume controls and fan speeds to obtain specified air delivery with minimum noise level. Rebalance as required to accomplish this. Simulate fully loaded filters during test.

3.3.3 Set grille deflections as noted on plans. Modify deflections if required to eliminate drafts or objectionable air movement.

3.3.4 Record air terminal velocity after completion of balance work.
3.3.5 Record final grille and register deflection settings if different from that specified on contract drawings.

3.3.6 Record all fan speeds.

3.3.7 **Variable Volume Systems:** Measure static pressure at all major branches. Adjust fan controllers for minimum required static pressure at the end of each branch. Report the value of the minimum static pressure that will provide proper air flow in the TAB Report and set the static pressure controller for this value. Balance outlets. Check at both modulated and full cooling condition. Traverse main supply and return ducts. Balance the return system. All branches must be above the minimum required static pressure. The supply fan and return fan must track and deliver the proper air quantity with no objectionable noise. The system must be stable and operate properly at 50% load.

3.4 **Data Collection:**

3.4.1 In addition to the data required for any specified performance tests, measure and record the temperatures, pressures, flow rates, and nameplate data for all components listed herein.

3.4.2 It is the intent of this section to record data on balanced systems, under normal operating or design conditions.

3.4.3 **Temperatures:**

1. Outside dry and wet bulb temperatures.
2. Dry bulb temperature in each room and at least one wet bulb temperature in each zone.
3. Refrigerant liquid and suction temperatures.
4. Inlet and outlet temperature of each heat exchange device - both fluids.

3.4.4 **Pressures:**

1. Suction and discharge static pressure of each fan.
2. Suction and discharge pressure of each pump.
3. Each refrigerant suction and discharge pressure.
4. Water pressure drop through each heat exchanger.

3.4.5 **Flow rates:**

1. Flow rate through each fan.
2. Flow rate through each coil or heat exchange device.

3.4.6 **Nameplate Data:**

1. Complete nameplate data for all equipment.
2. Motor data to include horsepower, phase, voltage, RPM, full load nameplate current, fuse rating in disconnect switch, number or manufacturer's size designation, and ampere rating of overcurrent and low voltage protection devices in starters.

3.5 All test openings in ductwork shall be resealed in an approved manner.

**END OF SECTION 23 05 93**
SECTION 23 07 13

EXTERIOR INSULATION FOR DUCTWORK

1

GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Approval Submittals:

1.3.1 Product Data: Submit producer's data sheets and installation instructions on each insulation system including insulation, coverings, adhesives, sealers, protective finishes, and other material recommended by the manufacturer for applications indicated. Submit for:

1.3.1.1 Rigid duct insulation
1.3.1.2 Flexible duct insulation
1.3.1.3 Insulation for exterior ducts.

1.4 O&M Data Submittals: Submit a copy of all approval submittals. Include in O&M Manual.

2

PRODUCTS

2.1 Acceptable Manufacturers: Subject to compliance with requirements, provide insulation products by Knauf, Owens-Corning, Johns Manville, Certainteed.

2.2 Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, coverings, sealers, mastic, and adhesive) with a flame spread rating of 25 or less, and a smoke-developed rating of 50 or less as tested by ANSI/ASTM 84.

2.3 Rigid Fiberglass Insulation Board: ASTM C612, Class 1 (non load bearing). Boards shall be 3 pcf density with UL rated aluminum foil vapor barrier (FSK).

2.4 Flexible Fiberglass Insulation: ASTM C553, Type I, Class B-3 (temperature less than 350°F). Duct wrap shall be 1 pcf density with UL rated aluminum foil vapor barrier (FSK).

2.5 General Purpose Mastic: Benjamin Foster 35-00 Series, Insulcousitc VIAC Mastic, Childers CP-10, or approved equal. The final selection of this product for the specific application indicated is the responsibility of the insulation supplier. The insulation system must meet the specified application.

2.6 Vapor Barrier Sealant: Benjamin Foster 30-35, Insulcousitc IC-501, 3M EC-1378, Childers CP-30, or approved equal. Provide "Low Odor" type. The final selection of this product for the specific application indicated is the responsibility of the insulation supplier. The insulation system must meet the specified application.

2.7 Adhesive: Benjamin Foster 85-20, Insulcousitc IC-205, 3M EC-35, Childers CP-82, Childers CP-89, or approved equal. The final selection of this product for the specific application indicated is the responsibility of the insulation supplier. The insulation system must meet the specified application.

2.8 Fiber-Glas Mesh: 10x10 Mesh. Foster Mastafab or equal.

3

EXECUTION

3.1 Insulate all supply, return and outdoor air ductwork exposed in mechanical rooms, mezzanines, fan lofts or in any finished spaces with 1½" thick rigid fiberglass insulation with vapor barrier.
3.2 Installation of Rigid Insulation:

3.2.1 Clean and dry ductwork prior to insulating. Butt insulation firmly together to ensure complete and tight fit over surfaces to be covered. Install insulation materials with smooth and even surfaces. Maintain integrity of aluminum vapor barrier wherever possible. Extend insulation without interruption through walls, floors and similar ductwork penetrations except where otherwise indicated.

3.2.2 Install with facing to the outside with a maximum of 25% compression. Butt all insulation joints firmly together. Longitudinal seam of the vapor retarder must be overlapped a minimum of 2”. Staples shall be outward clinch and placed approximately 6” on center. All penetrations, joints, seams, and damage to the facing shall be sealed with glass fabric and mastic prior to system startup. For rectangular ducts over 24” wide, secure the insulation to the bottom of the duct with mechanical fasteners spaced on 12” centers to reduce sag. Do not overcompress the insulation with the retainer. Larger ducts shall be secured with fasteners on 12-inch centers and 3 inches from all edges.

3.2.3 Apply open mesh glass fabric embedded in vapor barrier mastic. Then apply a second coat of general purpose mastic with aluminum grey color. This finish shall be complete over all rigid insulation.

3.3 Insulate all supply, return and outdoor air ductwork concealed above ceilings, in chases, or elsewhere, and the backs of all ceiling supply outlets with 2” thick fiberglass blanket insulation with vapor barrier.

3.4 Installation of Flexible Insulation:

3.4.1 Insulate round elbows and fittings with wrap such that thickness is equal to adjoining duct covering. Clean and dry ductwork prior to insulating.

3.4.2 Adhere insulation to duct with 50 percent coverage using approved insulation adhesive applied in 6-inch wide swaths with 6-inch spaces between swaths. Additionally secure insulation with perforated pins and Tuff-Bond or by self-sticking pins with a 3/8” self-tapping screw. Space on 12-inch centers and 3 inches from all edges. Ducts up through 24” wide only require one row of pins. Ducts over 24” wide shall have pins spaced as described herein.

3.4.3 Lap all joints 2 inches and seal joints with 4-inch wide strips of open mesh glass fabric embedded in two coats of general purpose mastic.

3.4.4 Seal all punctures and breaks in aluminum vapor barrier with open mesh glass fabric and vapor barrier sealant.

3.5 Installation of Insulation on Exterior Ducts:

3.5.1 Install 3” thick rigid insulation. Provide weatherproof finish.

3.5.2 Pitch the upper surface of the duct insulation to drain by installing a 6” wide insulation board (or equal) down the center of the duct prior to applying the insulation.

3.5.3 Clean and dry ductwork prior to insulating. Butt insulation firmly together to ensure complete and tight fit over surfaces to be covered. Install insulation materials with smooth and even surfaces. Maintain integrity of aluminum vapor barrier wherever possible. Extend insulation without interruption through walls, floors and similar ductwork penetrations except where otherwise indicated.

3.5.4 Install with facing to the outside with a maximum of 25% compression. Butt all insulation joints firmly together. Longitudinal seam of the vapor retarder must be overlapped a minimum of 2”. Staples shall be outward clinch and placed approximately 6” on center. All penetrations, joints, seams, and damage to the facing shall be sealed with glass fabric and mastic prior to system startup. For rectangular ducts over 24” wide, secure the insulation to the bottom of the duct with mechanical fasteners spaced on 12” centers to reduce sag. Do not overcompress the insulation with the retainer. Larger ducts shall be secured with fasteners on 12-inch centers and 3 inches from all edges.

3.5.5 Apply open mesh glass fabric embedded in vapor barrier mastic. Then apply a second coat of general purpose mastic with aluminum grey color.
3.5.6 Provide a smooth 0.016" aluminum jacket with seams positioned to shed water.

END OF SECTION 23 07 13
SECTION 23 07 16

INSULATION FOR HVAC EQUIPMENT AND PIPING

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-23 Basic Mechanical Materials and Methods Sections apply to work of this section.

1.3 Approval Submittals:

1.3.1 Product Data: Submit producer's data sheets and installation instructions on each insulation system including insulation, coverings, adhesives, sealers, protective finishes, and other material recommended by the manufacturer for applications indicated. Submit for:

1.3.1.1 Flexible unicellular piping insulation

1.4 O&M Data Submittals: Submit a copy of all approval submittals. Include in O&M Manual.

2 PRODUCTS

2.1 Acceptable Manufacturers: Subject to compliance with requirements, provide insulation products by Armstrong, Johns Manville, Knauf, Owens Corning, Pittsburgh Corning, U.S. Rubber, or approved equal. All products shall be asbestos-free.

2.2 Flame/Smoke Ratings: Provide composite mechanical insulation (insulation, jackets, coverings, sealers, mastics, and adhesive) with a flame-spread rating of 25 or less, and a smoke-developed rating of 50 or less, as tested by ANSI/ASTM E84.

2.3 Pipe Insulation Materials:

2.3.1 Flexible Unicellular Pipe Insulation: ASTM C534, Type I. (Tubular, suitable for use to 200°F.)

2.3.2 Staples, Bands, Wires, and Cement: As recommended by the insulation manufacturer for applications indicated.

2.3.3 Adhesives, Sealers, Protective Finishes: Products recommended by the insulation manufacturer for the application indicated.

2.3.4 Jackets: ASTM C921, Type I (vapor barrier) for piping below ambient temperature, Type II (vapor permeable) for piping above ambient temperature. Type I may be used for all piping at Installer's option.

3 EXECUTION

3.1 General:

3.1.1 Install thermal insulation products in accordance with manufacturer's written instructions, and in compliance with recognized industry practices to ensure that insulation serves intended purpose.

3.1.2 Install insulation materials with smooth and even surfaces and on clean and dry surfaces. Redo poorly fitted joints. Do not use mastic or joint sealer as filler for gapping joints and excessive voids resulting from poor workmanship.

3.1.3 Maintain integrity of vapor-barrier on insulation and protect it to prevent puncture and other damage. Label all insulation "ASBESTOS FREE".

3.1.4 Do not apply insulation to surfaces while they are hot or wet.
3.1.5 Do not install insulation until systems have been checked and found free of leaks. Surfaces shall be clean and dry before attempting to apply insulation. A professional insulator with adequate experience and ability shall install insulation.

3.1.6 Do not install insulation on pipe systems until acceptance tests have been completed except for flexible unicellular insulation. Do not install insulation until the building is "dried-in".

3.2 Flexible Unicellular Pipe Insulation:

3.2.1 Insulate the following piping systems:

3.2.1.1 Condensate drains from air conditioning units - ½" thick.

3.2.1.2 Refrigerant piping - ¾" thick.

3.2.1.3 Air compressor after-cooler piping - ¾" thick.

3.2.2 Apply insulation in accordance with the manufacturer's recommendations and instructions. Mitre cut insulation to fit pipe fittings. Use approved cement to seal all joints and ends in the insulation.

3.2.3 Insulation outside the building shall be protected by a smooth 0.016" thickness aluminum jacket secured with aluminum bands on 12" centers.

END OF SECTION 23 07 16
1  GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-23 Basic Mechanical Materials and Methods Sections apply to work of this section.

1.3 Extent of HVAC metal ductwork is indicated on drawings and in schedules, and by requirements of this section.

1.4 Refer to other Division-23 sections for exterior insulation of metal ductwork.

1.5 Refer to other Division-23 sections for ductwork accessories.

1.6 Codes and Standards:

1.6.1 SMACNA Standards: Comply with SMACNA's "HVAC Duct Construction Standards, Metal and Flexible" 1985 Edition for fabrication and installation of metal ductwork, unless otherwise noted.

1.6.2 NFPA 90A Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

1.6.3 NFPA 96 Compliance: Comply with NFPA 96 "Standard for Installation of Equipment for Removal of Smoke and Grease-Laden Vapors from Commercial Cooking Equipment".

1.7 Approval Submittals:

1.7.1 Product Data: Submit manufacturer's technical product data and installation instructions for the following.

1.7.1.1 Factory-fabricated ductwork

1.7.1.2 Sealants

1.7.1.3 Flexible duct

1.7.1.4 Spin-in fittings

1.7.1.5 Side take-off fittings

1.7.2 Shop Drawings: Submit scaled layout drawings of HVAC metal ductwork and fittings including, but not limited to, duct sizes, locations, elevations, and slopes of horizontal runs, wall and floor penetrations, and connections. Show interface and spatial relationship between ductwork and proximate equipment. Show modifications of indicated requirements, made to conform to local shop practice, and how those modifications ensure that free area, materials, and rigidity are not reduced.

2  PRODUCTS

2.1 Ductwork Materials:

2.1.1 Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces,
provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting.

2.1.2 **Galvanized Sheet Metal**: Except as otherwise indicated, fabricate ductwork from galvanized sheet steel complying with ASTM A 527, lockforming quality; with G 90 zinc coating in accordance with ASTM A 525; and mill phosphatized for exposed locations. Stamp gauge and manufacturer's identification on each sheet. Break sheets so that identification is exposed.

2.2 **Miscellaneous Ductwork Materials**:

2.2.1 **General**: Provide miscellaneous materials and products of types and sizes indicated and, where not otherwise indicated, provide type and size required to comply with ductwork system requirements including proper connection of ductwork and equipment.

2.2.2 **Duct Sealant**: Provide non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.

2.2.3 **Ductwork Support Materials**: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork. For exposed stainless steel ductwork, provide matching stainless steel support materials. For aluminum ductwork, provide matching supports unless materials are electrolytically separated from ductwork.

2.2.4 **Flexible Ducts**: Provide flexible ductwork with an R-value of R-6. The use of flexible ductwork for connection of supply air including terminal units and return air devices is acceptable only where shown on the drawings.

2.2.4.1 **Construction**: Provide reinforced metalized polyester jacket that is tear and puncture resistant, air tight inner core with no fiberglass erosion in the air stream and an encapsulated wire helix. Flexible ductwork shall have a recommended operating pressure of 6" w.g. for sizes 4" through 12" diameter and 4" w.g. for sizes 14" through 20" diameter. All diameters shall be suitable for a negative operating pressure of 0.75" w.g. Flexible ductwork shall meet the requirements of UL-181, the Florida Energy Code, SBCC, NFPA 90A and NFPA 90B.

2.2.4.2 **Acceptable Manufacturers**: Subject to compliance with requirements, provide R-6 flexible ductwork by: Atco 36, Flexmaster 8M-R6 or Thermaflex M-KE R6.

2.2.5 **Spin-in and Side Take-off Fittings**: Provide round branch run-outs as follows.

2.2.5.1 Supply air diffuser connections shall be conical with damper and one inch high insulation stand-off equal to Crown 3200 DS or Flexmaster CBDE-BO.

2.2.5.2 Return air grille connections shall be straight sided with damper and one inch high insulation stand-off equal to Crown 724-D5 or Flexmaster FLD-BO.

2.2.5.3 Exhaust air grille connections shall be straight sided with damper equal to Crown 724 or Flexmaster FLD.

2.2.5.4 Where duct height does not permit the use of conical spin-in fittings, use low profile side take-off fittings equal to Crown 3300-DS or Flexmaster STOD-BO.

2.2.6 **Fittings**: Provide radius type fittings fabricated of multiple sections with maximum 15° change of direction per section. Unless specifically detailed otherwise, use 45° laterals and 45° elbows for branch takeoff connections. Where 90° branches are indicated, provide conical type tees.
Fabrication:

2.3.1 Shop fabricate ductwork in 4, 8, 10 or 12-ft lengths, unless otherwise indicated or required to complete runs. Preassemble work in shop to greatest extent possible, so as to minimize field assembly of systems. Disassemble systems only to extent necessary for shipping and handling. Match-mark sections for reassembly and coordinated installation.

2.3.2 Shop fabricate ductwork of gauges and reinforcement complying with SMACNA "HVAC Duct Construction Standards", except provide sealant at all joints. Supply duct between AHU discharge and terminal units shall be minimum 4" pressure class. Duct downstream of terminal units, supply duct from air conditioning units and all return and exhaust duct shall be minimum 2" pressure class unless otherwise noted.

2.3.3 Fabricate duct fittings to match adjoining ducts, and to comply with duct requirements as applicable to fittings. Except as otherwise indicated, fabricate elbows with center-line radius equal to 1½ times associated duct width; and fabricate to include turning vanes in elbows where shorter radius is necessary. Limit angular tapers to 30° for contracting tapers and 20° for expanding tapers.

2.3.4 Fabricate ductwork with accessories installed during fabrication to the greatest extent possible. Refer to Division-23 section "Ductwork Accessories" for accessory requirements.

2.4 Factory-Fabricated Low Pressure Ductwork (Maximum 2" W.G.):

2.4.1 Material: Galvanized sheet steel complying with ASTM A 527, lockforming quality, with ASTM A 525, G90 zinc coating, mill phosphatized.

2.4.2 Gauge: 28-gauge minimum for round ducts and fittings, 4" through 8" diameter. 26-gauge minimum 9" through 14", 24-gauge minimum 15" through 26".

2.4.3 Elbows: One piece construction for 90° and 45° elbows 14" and smaller. Provide multiple gore construction for larger diameters with standing seam circumferential joint.

2.4.4 Divided Flow Fittings: 90° tees, constructed with saddle tap spot welded and bonded to duct fitting body.

2.4.5 Acceptable Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork by Semco Mfg., Inc. or United Sheet Metal Div., United McGill Corp, or approved equal.

2.5 Factory-Fabricated High Pressure Ductwork (3" W.G. and Higher):

2.5.1 Round Ductwork: Construct of galvanized sheet steel complying with ASTM A 527 by the following methods and in minimum gauges listed.

<table>
<thead>
<tr>
<th>Diameter</th>
<th>Minimum Gauge</th>
<th>Method of Manufacture</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot; to 14&quot;</td>
<td>26</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>15&quot; to 26&quot;</td>
<td>24</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>27&quot; to 36&quot;</td>
<td>22</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>37&quot; to 50&quot;</td>
<td>20</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>51&quot; to 60&quot;</td>
<td>18</td>
<td>Spiral Lockseam</td>
</tr>
<tr>
<td>Over 60&quot;</td>
<td>16</td>
<td>Longitudinal Seam</td>
</tr>
</tbody>
</table>

Provide locked seams for spiral duct; fusion-welded butt seam for longitudinal seam duct.

2.5.2 Fittings and Couplings: Construct of minimum gauges listed. Provide continuous welds along seams.
2.5.2 Flat-Oval Ductwork: Construct of galvanized sheet steel complying with ASTM A 527, of spiral lockseam construction, in minimum gauges listed.

<table>
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<tr>
<th>Diameter</th>
<th>Minimum Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot; to 36&quot;</td>
<td>20</td>
</tr>
<tr>
<td>38&quot; to 50&quot;</td>
<td>18</td>
</tr>
<tr>
<td>Over 50&quot;</td>
<td>16</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Maximum Width</th>
<th>Minimum Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 25&quot;</td>
<td>24</td>
</tr>
<tr>
<td>25&quot; to 48&quot;</td>
<td>22</td>
</tr>
<tr>
<td>49&quot; to 70&quot;</td>
<td>20</td>
</tr>
<tr>
<td>Over 70&quot;</td>
<td>18</td>
</tr>
</tbody>
</table>

Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams.

<table>
<thead>
<tr>
<th>Maximum Width</th>
<th>Minimum Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 37&quot;</td>
<td>20</td>
</tr>
<tr>
<td>37&quot; to 50&quot;</td>
<td>18</td>
</tr>
<tr>
<td>Over 50&quot;</td>
<td>16</td>
</tr>
</tbody>
</table>

2.5.3 Internally Insulated Duct and Fittings: Construct with outer pressure shell, 1" thick insulation layer, and perforated inner liner. Construct shell and liner of galvanized sheet steel complying with ASTM A 527, of spiral lockseam construction, use longitudinal seam for over 59", in minimum gauges listed.

<table>
<thead>
<tr>
<th>Nominal Duct Diameter</th>
<th>Outer Shell</th>
<th>Inner Liner</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot; to 12&quot;</td>
<td>26 ga.</td>
<td>24 ga.</td>
</tr>
<tr>
<td>13&quot; to 24&quot;</td>
<td>24 ga.</td>
<td>24 ga.</td>
</tr>
<tr>
<td>25&quot; to 34&quot;</td>
<td>22 ga.</td>
<td>24 ga.</td>
</tr>
<tr>
<td>35&quot; to 48&quot;</td>
<td>20 ga.</td>
<td>24 ga.</td>
</tr>
<tr>
<td>49&quot; to 58&quot;</td>
<td>18 ga.</td>
<td>24 ga.</td>
</tr>
<tr>
<td>Over 59&quot;</td>
<td>16 ga.</td>
<td>20 ga.</td>
</tr>
</tbody>
</table>

Fittings and Couplings: Construct of minimum gauges listed. Provide continuous weld along seams of outer shell.

<table>
<thead>
<tr>
<th>Nominal Duct Diameter</th>
<th>Outer Shell</th>
<th>Inner Liner</th>
</tr>
</thead>
<tbody>
<tr>
<td>3&quot; to 34&quot;</td>
<td>20 ga.</td>
<td>20 ga.</td>
</tr>
<tr>
<td>36&quot; to 48&quot;</td>
<td>18 ga.</td>
<td>20 ga.</td>
</tr>
<tr>
<td>Over 48&quot;</td>
<td>16 ga.</td>
<td>20 ga.</td>
</tr>
</tbody>
</table>

Inner Liner for Straight Duct: Perforate with 3/32" holes for 22% open area. Provide metal spacers welded in position to maintain spacing and concentricity. Provide a plastic film between the perforated liner and insulation to act as a vapor barrier.

Inner Liner for Fittings: Solid sheet metal. Provide metal spacers welded in position to maintain spacing and concentricity.

Mylar Film: Provide interior mylar film on interior liner.
Optional Ducts and Fittings: At Installer's option, provided that certified tests by Manufacturer show that rigidity and performance is equivalent to SMACNA standard gauge ductwork, provide ducts and fittings as follows:

Ducts: Construct of Manufacturer's standard gauge, with spiral lock seam and intermediate standing rib.

Fittings: Construct by fabricating with spot welding and bonding with neoprene-base cement in lieu of continuous weld seams.

Acceptable Manufacturers: Subject to compliance with requirements, provide factory-fabricated ductwork Semco Mfg., Inc. or United Sheet Metal Div., United McGill Corp., or approved equal.

EXECUTION

General: Examine areas and conditions under which HVAC metal ductwork is to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

Installation Of Metal Ductwork:

General: Assemble and install ductwork in accordance with recognized industry practices which will achieve air-tight (5% leakage for systems rated 3” and under; 1% for systems rated over 3") and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8” misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.

Supports: Install concrete inserts for support of ductwork in coordination with formwork, as required to avoid delays in work. Install self-drilling screw anchors in prestressed concrete or existing work.

Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements. Seal joints in round or oval ductwork with hard cast or shrink bands, and sheet metal screws, or by welding. High velocity rectangular ducts shall have approved joints and be made airtight with sealer or welding.

Routing: Locate ductwork runs, except as otherwise indicated, vertically and horizontally. Avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct useable space or block access for servicing building and its equipment. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building. Limit clearance to ½” where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1” clearance outside of insulation. In finished and occupied spaces, conceal ductwork from view by locating in mechanical shafts, hollow wall construction or above suspended ceilings, unless specifically noted as "Exposed". Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.

Electrical Equipment Spaces: Do not route ductwork through transformer vaults or other electrical equipment spaces and enclosures.

Penetrations: Where ducts pass through interior partitions and exterior walls, and are exposed to view, conceal space between construction opening and duct or duct insulation with sheet metal flanges of
same gauge as duct. Overlap opening on 4 sides by at least 1½". Fasten to duct and substrate. Where ducts pass through fire-rated floors, walls, or partitions, provide firestopping between duct and substrate.

3.2.7 Coordination: Coordinate duct installations with installation of accessories, dampers, coil frames, equipment, controls and other associated work of ductwork system.

3.2.8 Installation: Install metal ductwork in accordance with SMACNA HVAC Duct Construction Standards. Fan discharge outlet ducts shall be installed correctly with regard to "system effect" per AMCA Publication 201.

3.3 Installation of Flexible Ducts:

3.3.1 Maximum Length: For any duct run using flexible ductwork, do not exceed 5'-0" extended length. Flexible duct shall only be allowed as detailed on the drawings.

3.3.2 Installation: Install in accordance with Section III of SMACNA's "HVAC Duct Construction Standards, Metal and Flexible". Support flexible ducts to eliminate pinching and kinking which would restrict flow.

3.3.3 Downstream of VAV Boxes: Peel back insulation and slide the inner core over the spin-in or diffuser neck, seal with duct sealant and install Panduit strap tightly. Slide insulation back over the inner core and install another Panduit strap over the insulation outer jacket. Tape is not acceptable.

3.3.4 Upstream of VAV Boxes: Install same as downstream, except use stainless steel worm-gear clamps instead of Panduit straps.

3.3.5 Seal all exposed edges of fiberglass insulation with glassfab and mastic.

3.4 Installation of exhaust ductwork serving shower rooms, dishwashers, and other areas where moisture laden air is present shall provide watertight seams. Ducts carrying moisture laden air shall be soldered galvanized steel welded stainless steel welded aluminum. Ducts shall be sloped to drain without pockets. Install 1¼" drains run to safewaste where required.

3.5 Leakage Tests: After each duct system is completed, test for duct leakage in accordance with Sections 3 and 5 of the SMACNA HVAC Air Duct Leakage Test Manual. Test pressure shall be equal to pressure class of duct, less 0.5" static pressure. Repair leaks and repeat tests until total leakage is less than 5% of system design air flow for low pressure systems and less than 1% for systems rated over 3".

3.6 Equipment Connections: Connect metal ductwork to equipment as indicated, provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery. Provide access doors as indicated.

3.7 Clean ductwork internally free of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration. Keep ducts closed with poly during construction to prevent contamination by construction dust and debris.

3.8 Balancing: Refer to Division-23 section "Testing, Adjusting, and Balancing" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent in balancing process.

3.9 System Adjustment: Adjust the system to provide functional operation to the extent possible, and leave ready for Testing and Balancing work. It is not the intent of this section to provide final testing and balancing, but to leave the system operational with a minimum of noise.
SECTION 23 33 00

DUCTWORK ACCESSORIES

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Extent of ductwork accessories work is indicated on drawings and in schedules, and by requirements of this section.

1.4 Refer to other Division-23 sections for testing, adjusting, and balancing of ductwork accessories; not work of this section.

1.5 Codes and Standards:

1.5.1 SMACNA Compliance: Comply with applicable portions of both SMACNA "HVAC Duct Construction Standards, Metal and Flexible" and "Fire, Smoke and Radiation Damper Installation Guide for HVAC Systems".

1.5.2 UL Compliance: Construct, test, and label fire dampers in accordance with UL Standard 555 "Fire Dampers and Ceiling Dampers". Construct, test and label smoke dampers in accordance with UL Standard 555S "Leakage Rated Dampers for use in Smoke Control Systems".

1.5.3 NFPA Compliance: Comply with applicable provisions of NFPA 90A "Air Conditioning and Ventilating Systems" pertaining to installation of ductwork accessories.

1.6 Approval Submittals:

1.6.1 Product Data: Submit manufacturer's technical product data for each type of ductwork accessory, including dimensions, capacities, and materials of construction; and installation instructions as follows:

1.6.1.1 Low pressure manual dampers

1.6.1.2 Control dampers

1.6.1.3 Duct access doors

1.6.1.4 Flexible connections

1.6.2 O&M Data Submittals: Submit manufacturer's maintenance data including parts lists for fire dampers, smoke dampers. Include this data, product data, and a copy of approval submittals in O&M manual.

2 PRODUCTS

2.1 Dampers:

2.1.1 Low Pressure Manual Dampers: Provide 16 gauge dampers of single-blade type (12" maximum blade width) or multiblade type. Damper blades to be gang-operated from a single shaft with nylon or ball bearings on each end. Provide indexed locking quadrant. Parallel or opposed blade style is acceptable. Provide 2" standoff on locking quadrant for externally insulated duct.

2.1.2 Control Dampers: Provide dampers with parallel blades for 2-position control or opposed blades for modulating control. Construct blades of 16-ga. steel. Provide heavy-duty molded self-lubricating nylon bearings and 1/2" diameter steel axles spaced on 9" centers. Provide sponge rubber or felt blade edges. Construct frame of 2" x 1/2" x 1/8" steel channel for face areas 25 sq. ft. and under; 4" x 1-1/4" x 16-ga. channel for face areas over 25 sq. ft. Provide galvanized steel finish with aluminum touch-up.
Actuators (motors) are provided by control contractor.

2.1.3 **Acceptable Manufacturers**: Subject to compliance with requirements, provide dampers by Air Balance, American Warming & Ventilating, Arrow Louver and Damper, Penn Ventilator Co., or Ruskin Mfg. Co.

2.2 **Turning Vanes**: Provide manufactured or fabricated single wall turning vanes and vane runners, constructed in accordance with SMACNA "HVAC Duct Construction Standards".

2.3 **Duct Access Doors**:

2.3.1 **General**: Provide duct access doors of size indicated, or as required for duty indicated.

2.3.2 **Construction**: Construct of same or greater gauge as ductwork served. Provide insulated doors for insulated ductwork. Provide flush frames for uninsulated ductwork, extended frames for externally insulated duct. Provide one side hinged, other side with one handle-type latch for doors 12" high and smaller, 2 handle-type latches for larger doors.

2.3.3 **Acceptable Manufacturers**: Subject to compliance with requirements, provide access doors by Air Balance, Inc., Duro Dyne Corp., Ruskin Mfg. Co., or Ventfabs, Inc.

2.4 **Flexible Connections**:

2.4.1 **General**: Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.

2.4.2 **Acceptable Manufacturers**: Subject to compliance with requirements, provide products by one of the following: Duro Dyne Corp., Flexaust (The) Co., or Ventfabs, Inc.

3 **EXECUTION**

3.1 **Examine areas and conditions** under which ductwork accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 **Installation of Ductwork Accessories**:

3.2.1 **Install ductwork accessories** in accordance with manufacturer's installation instructions, with applicable portions of details of construction as shown in SMACNA standards, and in accordance with recognized industry practices to ensure that products serve intended function.

3.2.2 **Install balancing dampers** at all main ducts adjacent to units in return air, outside air and where indicated.

3.2.3 **Install control dampers** in the outside air duct return air duct for each air handler. Damper operator provided by control contractor.

3.2.4 **Install turning vanes** in square or rectangular 90° elbows in supply, return, and exhaust air systems, and elsewhere as indicated.

3.2.5 **Install access doors** to open against system air pressure, with latches operable from either side, except outside only where duct is too small for person to enter. Install on entering air side of reheat coils. Install at fire dampers and smoke dampers. Opening size shall be per NFPA 90A for servicing fire and smoke dampers. Provide label with 1-1/2" letters to indicate location of fire protection devices.

3.2.6 **Install flexible connections** in ductwork such that the clear length of the connector is approximately two inches. Provide thrust restraints as required. Flexible material shall not be so slack as to take a definite concave or convex shape during fan operation.
3.2.7 Coordinate with other work, including ductwork, as necessary to interface installation of ductwork accessories properly with other work.

3.3 Operate installed ductwork accessories to demonstrate compliance with requirements. Test for air leakage while system is operating. Repair or replace faulty accessories as required to obtain proper operation and leakproof performance.

3.4 Adjusting And Cleaning:

3.4.1 Adjusting: Adjust ductwork accessories for proper settings. Install fusible links in fire dampers and adjust for proper action.

3.4.2 Final positioning of manual dampers is specified in Division-23 section "Testing, Adjusting, and Balancing". However, the system shall be left functional with all dampers open or throttled.

3.4.3 Cleaning: Clean factory-finished surfaces. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

END OF SECTION 23 33 00
SECTION 23 34 00

FANS

1  GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Extent of fan work required by this section as indicated on drawings and schedules, and by requirements of this section.

1.4 Coordination:

1.4.1 Refer to Division-7 sections for installation of prefabricated roof curbs; not work of this section. Furnishing prefabricated roof curbs is part of this section’s work.

1.4.2 Refer to Division-23 section "Testing, Adjusting, and Balancing" for balancing of fans.

1.4.3 Refer to Division-23 HVAC control systems sections for control work required in conjunction with fans.

1.4.4 Refer to Division-26 sections for power supply wiring from power source to power connection on fans. Division-26 work will include starters, disconnects, and required electrical devices, except where specified as furnished, or factory-installed, by manufacturer.

1.5 Codes and Standards:

1.5.1 AMCA Compliance: Provide fans which have been tested and rated in accordance with AMCA standards, and bear AMCA Certified Ratings Seal.

1.5.2 UL Compliance: Provide fans which are listed by UL and have UL label affixed.

1.6 Approval Submittals:

1.6.1 Product Data: Submit manufacturer's technical data for fans, including specifications, capacity ratings, dimensions, weights, materials, accessories furnished, and installation instructions. Submit assembly-type drawings showing unit dimensions, construction details, methods of assembly of components, and field connection details. Include statement that resin selection is suitable for chemical resistance to the specific application at 170ºF.

1.6.1.1 Fans

1.6.1.2 Vibration Control

1.7 O&M Data Submittals: Submit maintenance data and parts list for each type of fan, accessory, and control. Include these data, a copy of approved submittals, and wiring diagrams in O&M Manual.

2  PRODUCTS

2.1 General: Except as otherwise indicated, provide standard prefabricated fans of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation. Provide accessories as listed in the schedule on the drawings and as described herein. Motors shall be high efficiency per Division-23 section "Motors".

2.2 Acceptable Manufacturers: Subject to compliance with requirements provide fans manufactured by Acme, Greenheck, Loren Cook, Penn or approved equal unless otherwise noted herein.

2.3 Centrifugal Ceiling Exhausters:
2.3.1 **Fan Assembly**: Provide steel housing, plastic or aluminum grille, backdraft damper, statically and dynamically balanced fan wheel, permanently lubricated motor with internal thermal overloads, vibration isolation and all required mounting hardware and brackets. Provide acoustically treated housing for all fans larger than 60 cfm. Mounting type shall be as indicated on the drawings or on the schedule.

2.3.2 **Connectors**: Provide adaptors, connectors, and eave elbows as required to connect fan discharges to outlets.

2.3.3 **Outlets**: Provide where shown on the drawings (or required by the installation) wall caps, vent caps, or roof jacks, each with birdscreen, to match fans and surrounding construction.

2.4 **Propeller Wall Fans**:

2.4.1 **Housing**: Provide heavy duty all-welded steel housing and supports with epoxy finish. Panels shall have streamlined orifices.

2.4.2 **Fan**: Provide air foil type steel or aluminum propellers.

2.4.3 **Drive**: Provide direct or belt drive as scheduled with pre-lubricated, ball bearing, continuous duty type motors. Provide vibration isolation equipment for the entire drive.

2.4.4 **Wall Collar or Housing**: Provide galvanized steel fan wall collar or housing as required.

2.4.5 **Fan Guard**: Provide OSHA approved galvanized steel mesh fan guard.

2.5 **Utility Sets**:

2.5.1 **Housing**: Provide welded steel fan housing with epoxy coating inside and out. Provide flanged discharge in the configuration shown on the drawings or indicated in the schedule. Provide companion flange for discharge duct. Provide shaft seal and scroll drain with plug.

2.5.2 **Fan Wheel**: Provide aluminum, air foil type, statically and dynamically balanced.

2.5.3 **Drive**: Provide belt drive as scheduled, with prelubricated ball bearing, continuous duty, open drip proof motor. Provide weatherproof enclosure. Provide vibration isolation equipment to mount entire fan assembly.

2.6 **Fan Accessories and Features**: Where indicated on the schedule or drawings provide accessories and features listed herein.

1 **Belt drive**: Belt drives shall include cast iron, variable pitch sheaves, heavy duty belts, and 1750 rpm motors. The drive shall be adjustable to plus or minus 20% of scheduled flow. Provide fixed sheaves after balancing is complete.

2 **Direct drive**: Direct drives shall have multispeed motors or speed controllers to achieve scheduled flow.

3 **Bird Screens**: Provide bird screens of 1/2" mesh aluminum or galvanized steel hardware cloth.

4 **Backdraft Dampers**: Provide where indicated aluminum louvered dampers with felt-edged blades and nylon bearings.

5 **Disconnect Switches**: Provide factory installed local disconnecting means.

6 **Thermal Overloads**: Provide internal thermal overloads.
**Speed Controller**: Provide where indicated solid state speed controller for remote mounting.

**Motorized Dampers**: Provide where indicated aluminum louvered dampers with felt-edged blades and nylon bearings with 120 volt motors wired to operate with the fan. Provide limit switch to prevent fan starting until damper is at least half open.

**Explosion-proof motor**: Provide where indicated explosion proof motors.

2.7 **Vibration Isolation**: Mount fans on vibration isolators in accordance with the requirements of Division-23 section "Vibration Isolation" and the following list.

2.7.1 **Hangers**: Type HA1, HA2, HA3.

**EXECUTION**

3.1 **General**: Except as otherwise indicated or specified, install fans in accordance with manufacturer's installation instructions and recognized industry practices to insure that fans serve their intended function.

3.2 **Coordinate fan work** with work of roofing, walls, and ceilings as necessary for proper interfacing. Framing of openings, caulking, and curb installation is not work of this section.

3.3 **Ductwork**: Refer to Division-23 section "Ductwork". Connect ducts to fans in accordance with manufacturer's installation instructions. Provide flexible connections in ductwork at fans.

3.4 **Install fans on vibration isolation equipment as required.** Set level and plumb.

3.5 **Electrical Wiring**: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to electrical Installer. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of Division-26 sections. Verify proper rotation direction of fan wheels. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

3.6 **Remove** shipping bolts and temporary supports within fans. Adjust dampers for free operation.

3.7 **Testing**: After installation of fans has been completed, test each fan to demonstrate proper operation of units at performance requirements specified. When possible, field correct malfunctioning units, then retest to demonstrate compliance. Replace units which cannot be satisfactorily corrected.

3.8 **Cleaning**: Clean factory-finished surfaces. Remove all tar and soil. Repair any marred or scratched surfaces with manufacturer's touch-up paint.

**END OF SECTION 23 34 00**
SECTION 23 34 43
HIGH VOLUME LOW SPEED FANS

PART 1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Extent of fan work required by this section as indicated on drawings and schedules, and by requirements of this section.

1.4 SUBMITTALS

A. Submit under provisions of Section 01300.

B. Product Data: Manufacturer’s data sheets on each product to be used shall include:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Power and mounting requirements.

C. Application Drawings: Submit plan, section, elevation and isometric views as necessary to convey the information required to detail all installation conditions for each unit specified.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: The manufacturer shall be the sole source for design, engineering, manufacturing and warranty claims handling.

B. Installer Qualifications: Any and all work outside the scope of the installation guide shall be outsourced. Factory trained installers are recommended and available upon request.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity and ventilation) within limits recommended by manufacturer for optimal results. Do not install products in environmental conditions outside the manufacturer's absolute limits.

1.7 COORDINATION

A. The fan shall be capable of receiving a stop command from the fire panel, an ASD (Aspirating Smoke Detection) device, or any number of smoke, flame or heat detectors.

B. The fans shall be as follows:
   1. The fan shall meet the air velocity requirements of FM Global’s 2.0 data sheet for ESFR sprinklers.
   2. If required by the local fire prevention authority or desired by the purchaser, the fan shall be wired into the building’s fire suppression system so that the fan will automatically shut off within a maximum of 90 seconds after sprinklers are activated. To facilitate this automatic shut-down, the fan shall include a Variable Frequency Drive (VFD) within the control panel. The low voltage wire and relay needed to accomplish this must be supplied by the Fire Alarm installer.
   3. Upon fire detection as described above, the fans shall coast to stop as required by NFPA guidelines.

1.8 WARRANTY

A. The manufacturer shall repair or replace warranted defective parts as follows:
   1. Lifetime warranty on airfoils, hub, frame and mounting.
   2. Twelve-year service life prorated limited warranty on all other components, which include but are not limited to:
a. Motor
b. Gear reducer
c. VFD

B. At project closeout, provide to Owner or Owner's Representative an executed copy of The manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

PART 2 PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Acceptable Manufacturer: MacroAir Technologies, Inc., Big Ass Fans, or approved equal.

B. Requests for substitutions will be considered in accordance with provisions of Section 01600.

2.2 COMMERCIAL / INDUSTRIAL HVLS FANS

A. Airfoils

The fan shall be equipped with six (6) NASA developed XL airfoils. The airfoils shall consist of anodized 6061 T4 precision extruded aluminum and be of the MacroAir XL design, with 8 through 20 foot fan diameters available. The airfoils shall be connected to six (6) individual aluminum 6005 T6 struts by means of two (2) 5/16-24 x 2-inch grade 5 hex bolts, two (2) 5/16-inch flat washers and two (2) 5/16-inch nylon lock nuts per airfoil.

1. Number of Airfoils: 6.
4. Optional Airfoil Finish: Custom powder coated colors per Drylac RAL color chart.

B. Motor

The fan shall be equipped with a Nord 0.5 Hp, 3-phase motor. The motor shall be ventilated, capable of continuous operation up to 104°F (40°C) ambient conditions.

1. HP: 0.5.
2. 3-Phase.
3. RPM: 1720.
5. Full Load Amp draw: 0.95.
6. Insulation Class: F.
8. Enclosure: TEFC.

C. Onboard Variable Frequency Drive (VFD)

VFD shall operate on carrier frequency of no less than 16 kHz in order to minimize sound. The VFD shall have a UL, CE and RoHS rating. The fan shall include a NEMA 4X Remote Switchbox for wall mounting and 100 feet of remote cable (up to 600 feet in length optional). Remote Switchbox shall include a forward, off, reverse and a low-medium-high control knob.

1. Electrical Requirements
   a. 120VAC single (1) phase 50/60 Hz.
   b. 208-240VAC single (1) phase 50/60 Hz.
   c. 208-240VAC three (3) phase 50/60 Hz.
2. Pre-programmed VFD with dynamic acceleration and deceleration.
3. MODBUS option available.
4. Fire panel integration contacts.

D. Gear Reducer

The fan shall be equipped with a Nord sealed gear reducer. The gear reducer shall be an inline 2-stage helical gear reducer, precision finished for low noise and high performance.

1. Reducer Type: 2-Stage Helical.
2. Lubrication: Mobil SHC 636.
7. Output Shaft: Stainless steel 1-1/8” diameter.
8. Service Factor: 1.15.
9. Maximum Output Torque: 243 IN-LB.

E. Mounting and Frame

The fan mounting system shall be equipped with hardware, no less than SAE grade 5 for safe installation. The fan shall be equipped with an adjustable mount. The fan shall be properly equipped for multiple mounting options for I-beam, Purlin and Glulam applications (specified upon order).

2. Optional Mounting Hardware: Glulam Mounting Brackets.
4. Mounting Drops: Extensions available in one (1) to ten (10) foot lengths in one (1) foot increments and available in custom sizes.
7. Optional Frame Finish: Custom powder coated colors per Drylac RAL color chart.
9. Optional Mount Finish: Custom powder coated colors per Drylac RAL color chart.

F. Hybrid Hub

The fan shall be equipped with a patent-pending, aluminum hybrid hub. The hybrid hub shall have six (6) removable, black anodized, 6005 T6 aluminum H-beam struts. The struts shall be designed with airfoil guides to ensure precision alignment and enable airfoils to be inverted for full CFM output in either reverse or forward operation.

4. Hardware: Twelve (12) 3/8-24 x 1 ¾ -inch Grade 8 Hex Bolts.
5. Hardware: Twelve (12) 3/8-inch flat washers (SAE).

G. Safety System

The fan shall include a patented two-part interlocking hybrid hub safety system. The hybrid hub safety system shall prevent hub separation from gear reducer. The fan shall include a lowest point safety cable attached to the frame. If using more than two feet of extension, the fan shall include four (4) guy wires attached to the building structure at recommended 45° angles to level and secure frame position. The fan shall include one-piece airfoil retainer links to prevent airfoil separation from the hybrid hub. Each fan shall be E-stop compatible for fire and building automated systems (BAS).

1. Safety Cable Material: 1/4” x 7 x 19 Aircraft Grade Braided Steel.
3. Guy Wire Material: 1/8” x 7 x 10 Aircraft Grade Braided Steel.
8. Safety Retainer Plate Finish: Black powder coated.
10. Airfoil Retainer Link Finish: Clear Zinc.

PART 3 EXECUTION

3.1 PREPARATION

A. Check accuracy of dimensions indicated for openings to receive fans.
B. Check location and availability of utility services to ensure proper voltage and installation preparation.
C. Coordinate location and installation of the HVLS Fans.
D. Ensure building structural members are sufficient to support the weight and operation of the fan. Consult professional engineer or registered architect as required.

3.2 INSTALLATION

A. Install units per manufacturer's written instructions.
B. Fan airfoil height to be a minimum of 10 feet from the floor in accordance with OSHA guidelines.
C. All safety and support features must be installed. These include any guy wires and safety cables as well as airfoil retainer locking features.
D. Adjust unit as required for proper operation in accordance with manufacturer’s installation instructions.
E. Securely anchor units.
F. Ensure that operating parts turn freely prior to initial startup.
G. Repair or replace damaged parts, dents, buckles, abrasions or other damage affecting appearance or serviceability, as acceptable to Architect.

3.3 PROTECTION

A. Protect finished Work until date of Substantial Completion.
B. Touch-up, repair or replace damaged products before Substantial Completion.

3.4 CLEANING

A. Clean Work per Section 01 74 00.
B. Clean and inspect fans per manufacturer's instructions.
C. Remove temporary protective cover at date of Substantial Completion.

END OF SECTION
SECTION 23 37 13
GRILLES, REGISTERS AND CEILING DIFFUSERS

1 GENERAL
1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.
1.3 Extent of air outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
1.4 Refer to other Division-23 sections for ductwork and duct accessories required in conjunction with air outlets and inlets and for balancing of air outlets and inlets; not work of this section.
1.5 Codes and Standards:
1.5.1 ADC Compliance: Test and rate air outlets and inlets in certified laboratories under requirements of ADC 1062 "Certification, Rating and Test Manual". Provide air outlets and inlets bearing ADC Certified Rating Seal.
1.5.2 NFPA Compliance: Install air outlets and inlets in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".
1.6 Approval Submittals:
1.6.1 Product Data: Submit manufacturer's technical product data for air outlets and inlets indicating construction, finish, and mounting details.
1.6.2 Performance Data: For each type of air outlet and inlet furnished, provide aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections and data as required.
1.7 O&M Data Submittals: Submit cleaning instructions for finishes and spare parts lists. Include this data and a copy of approval submittals in O&M manual.

2 PRODUCTS
2.1 General:
2.1.1 Except as otherwise indicated, provide manufacturer's standard grilles, registers, and ceiling diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation.
2.1.2 Manufacturers not listed in the following specification will not be considered for approval unless accepted by addendum prior to bid.
2.1.3 Performance: Provide grilles, registers and ceiling diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device equal to the basis of design.
2.1.4 Ceiling and Wall Compatibility: Provide grilles, registers and diffusers with border styles that are compatible with adjacent wall and ceiling systems, and that are specifically manufactured to fit into ceiling module or wall with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems and walls which will contain each type of ceiling diffuser, grille, or register.
2.1.5 Appearance: All grilles and registers shall be aluminum construction and all diffusers shall be steel or
aluminum construction, unless otherwise noted, with uniform matching appearance for each type of outlet. Ceiling mounted grilles and registers shall be set to be sight tight from the predominant exposure.

2.1.6 Finish: All ceiling mounted grilles, registers, and diffusers shall be finished with baked white enamel. Wall and door mounted grilles and registers shall be finished with clear anodized finish baked white enamel.

2.2 Acceptable Manufacturers: Subject to compliance with requirements, provide products by Titus or Metal Aire.

2.3 Square Ceiling Diffusers: Provide square face, adjustable, 360 degree pattern diffusers with one-piece stamped cones, no corner joints, round necks. Provide lay-in panel as required. Provide trim ring for diffusers in hard ceilings to allow opening to be used for access.

2.4 Return Grilles: Provide return grilles registers with one set of 45 degree fixed louvers, parallel to the long dimension. Provide opposed blade damper, screwdriver operated from the face. Provide mounting frame for all wall and plaster ceiling installations.

2.5 Sidewall Supply Grilles: Provide supply registers with two sets of individually adjustable airfoil registers, spaced at 3/4", with the front set parallel to the long dimension. Provide opposed blade damper, screwdriver operated from the face. Provide mounting frame.

2.6 Drum Louvers: Provide long throw diffusers with split vane.

3 EXECUTION

3.1 Coordinate installation with ceiling and light fixture installation. Locate ceiling outlets as indicated on architectural Reflected Ceiling Plans. Unless otherwise indicated, locate ceiling outlets in the center of acoustical ceiling modules with sides parallel to the grid.

3.2 Install air outlets and inlets in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

3.3 Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.

3.4 Set air volumes to values shown on the drawings so that the system is functional. Leave ready for test and balance contractor.

3.5 Furnish to Owner three operating keys for each type of outlet and inlet that require them; obtain receipt.

END OF SECTION 23 37 13
SECTION 23 37 26
WALL LOUVERS

PART 1  GENERAL

1.01 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.02 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.03 Extent of wall louver work is indicated by drawings and schedules, and by the requirements of this section.

1.04 Refer to other Division-23 sections for ductwork, duct accessories and controls work.

1.05 AMCA Compliance: Test and rate louvers in accordance with AMCA Standard 500. Provide AMCA certified rating seal. Ratings based on tests and procedures performed in accordance with AMCA 500-L and complying with the AMCA 511 Certified Ratings Program. AMCA Certified Ratings Seal applies to air performance, water penetration and wind driven rain ratings.

A. Product Qualifications:

1. Miami-Dade County, Florida Notice of Acceptance (NOA).


3. Louver shall be certified to Florida Building Code Testing Application Standards TAS 100(A) (Wind Driven Rain Resistance), TAS 201 (Large Missile Impact), TAS 202 (Uniform Static Air Pressure) and TAS 203 (Cyclic Wind Loading).

4. AMCA Listed for compliance to AMCA 540 Level E and AMCA 550 standards.

1.06 Approval Submittals:

A. Product data: Submit manufacturer's technical product data for louvers including: model number, accessories furnished, construction, finish, mounting details, performance data.

1.07 O&M Data Submittals: Submit maintenance data, including cleaning of finishes and a copy of approval submittals. Include in O&M manual.

PART 2  PRODUCTS

2.01 Acceptable Manufacturers: Subject to compliance with requirements, submit products by Ruskin, Greenheck, Arrow, American Warming and Ventilating, or AMCA labeled approved equal.

2.02 General: Except as otherwise indicated, provide manufacturer's standard louvers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation. Provide Kynar 500 coated, corrosion resistant finish and 5 year warranty; color to be selected by the Owner.

2.03 Substrate Compatibility: Provide louvers with 9 inch frame, flange and sill extension piece that are compatible with adjacent substrate, and that are specifically manufactured to fit into construction openings with accurate fit and adequate support, for weatherproof installation. Refer to general construction drawings and specifications for types of substrate which will contain each type of louver.

2.04 Materials: Construct of aluminum extrusions, Alloy 6063-T6 0.081” thick for frame and 0.081” thick for front blades and 0.060” thick for back blades. Weld units or use stainless steel fasteners.
2.05 **Sill Flashing:** Formed aluminum, 0.080" thick, upturned sides to prevent water leakage.

2.06 **Installation Angles:** Material: 1.375 x 2.25 inch x 0.125 inch thick continuous aluminum angles around louver perimeter for installation in concrete, deep CMU, steel and wood substrate wall systems.

2.07 **Installation Plates:** Material: 0.250 inch (6.4 mm) thick continuous aluminum flat or zee plates for installation in thin CMU substrate wall systems.

2.08 **Louver Screens:** On inside face of exterior louvers, provide 1/2" square mesh anodized aluminum wire bird screens mounted in removable extruded aluminum frames.

2.09 **Stationary Louvers:** Hurricane and impact rated louvers, basis of design is Greenheck EHV-901D.

A. **Performance Data:**

1. **Performance Ratings:** AMCA licensed.
   a. Based on testing 48 inches x 48 inches size unit in accordance with AMCA 500-L.

2. **Free Area:** 42 percent, nominal.

3. **Free Area Size:** 6.66 square feet.

4. **Maximum Recommended Air Flow through Free Area:** 2,155 feet per minute.

5. **Air Flow:** 10,431 cubic feet per minute.

6. **Maximum Pressure Drop (Intake):** 0.60 inches w.g.

7. **Water Penetration:** Beginning point of water penetration of 0.01 ounce per ft² of free area shall be above 1,250 feet per minute free area velocity.

8. **Wind Load Rating:** Maximum wind load of ±150 PSF.

9. **AMCA 500-L Wind Driven Rain Performance:** 99.9 percent effective at preventing water penetration through louver when tested at 50 miles per hour wind with 8 inches per hour rainfall and 2,155 feet per minute airflow through the free area. Penetration Class ‘A’ with Discharge Class (Intake) ‘3’ in accordance with AMCA 500-L Wind Driven Rain Test.

**PART 3 EXECUTION**

3.01 Install where shown on the drawings in accordance with the manufacturer's printed instruction and Florida Product Approval. Exercise care to prevent scratches.

3.02 Isolate dissimilar metals per the manufacturer’s recommendations.

3.03 Verify size of louvers shown on drawings prior to fabrication. Coordinate with wall openings. Sizes may be altered subject to approval by Engineer provided free area remains approximately the same as indicated.

**END OF SECTION 23 37 26**
Part 1 – General

1.01 SYSTEM DESCRIPTION

The variable capacity, heat pump heat recovery air conditioning system shall be a Mitsubishi Electric CITY MULTI VRF (Variable Refrigerant Flow) zoning system.

The S-Series system shall consist of the PUMY outdoor unit, multiple CITY MULTI indoor units, and M-NET DDC (Direct Digital Controls). The PUMY outdoor unit shall be a horizontal discharge, 208/230 volt, single-phase unit. Each CITY MULTI indoor unit or group of CITY MULTI indoor units shall be independently controlled.

1.02 QUALITY ASSURANCE

A. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label.

B. All wiring shall be in accordance with the National Electrical Code (N.E.C.).

C. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).

D. All units must meet or exceed the 2010 Federal minimum efficiency requirements and the ASHRAE 90.1 efficiency requirements for VRF systems. Efficiency shall be published in accordance with the Air-Conditioning, Heating, and Refrigeration Institute (AHRI) Standard 1230.

E. A full charge of R-410A for the condensing unit only shall be provided in the condensing unit.

1.03 DELIVERY, STORAGE AND HANDLING

A. Unit shall be stored and handled according to the manufacturer’s recommendation.

1.04 CONTROLS

A. The control system shall consist of a low voltage communication network of unitary built-in controllers with on-board communications and a web-based operator interface. A web controller with a network interface card shall gather data from this system and generate web pages accessible through a conventional web browser on each PC connected to the network. Operators shall be able to perform all normal operator functions through the web browser interface.

B. System controls and control components shall be installed in accordance with the manufacturer’s written installation instructions.

C. Furnish energy conservation features such as optimal start, night setback, request-based logic, and demand level adjustment of overall system capacity as specified in the sequence.

D. System shall provide direct and reverse-acting on and off algorithms based on an input condition or group conditions to cycle a binary output or multiple binary outputs.

E. Provide capability for future system expansion to include monitoring and use of occupant card access, lighting control and general equipment control.

F. System shall be capable of email generation for remote alarm annunciation.
G. Control system start-up shall be a required service to be completed by the manufacturer or a duly authorized, competent representative that has been factory trained in Mitsubishi Electric controls system configuration and operation. The representative shall provide proof of certification for Mitsubishi Electric Controls Applications Training indicating successful completion of no more than two (2) years prior to system installation. This certification shall be included as part of the equipment and/or controls submittals. This service shall be equipment and system count dependent and shall be a minimum of one (1) eight (8) hour period to be completed during normal working hours.

Part 2 – Warranty

2.01 The S-Series units shall be covered by the manufacturer’s limited warranty for a period of one (1) year parts and six (6) year compressor to the original owner from date of installation.

If the systems are:

1) designed by a certified CITY MULTI Diamond Designer using Diamond System Builder,

2) installed by a contractor that has successfully completed the Mitsubishi Electric three day service course, AND

3) verified with required materials submitted to and approved by the Mitsubishi Electric Service Department, which include:
   - As built Diamond System Builder file,
   - A one (1) hour Maintenance Tool record with system information, in Ordinary Control Mode (not initial),
   - Outdoor and Indoor unit dip switch settings
   - Outdoor unit(s) function settings,

then the units shall be covered by an extended manufacturer’s limited warranty for a period of ten (10) years to the original owner from date of installation.

In addition the compressor shall have a manufacturer’s limited warranty for a period of ten (10) years to the original owner from date of installation.

If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer.

This warranty shall not include labor.

2.02 Manufacturer shall have a minimum of thirty-three (33) years of HVAC experience in the U.S. market.

2.03 All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required. Registering and sign-in requirements which may delay emergency service reference are not allowed.

2.04 The CITY MULTI VRF system shall be installed by a contractor with extensive CITY MULTI install and service training. The mandatory contractor service and install training should be performed by the manufacturer.

Part 3 – Products

3.01 S-SERIES OUTDOOR UNIT

A. General:

The PUMY outdoor units shall be equipped with multiple circuit boards that interface to the M-NET controls system and shall perform all functions necessary for operation. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.
1. The sum of connected capacity of all CITY MULTI indoor units shall range from 50% to 130% of outdoor rated capacity.

2. Outdoor unit shall have a sound rating no higher than 59 dB(A).

3. Both refrigerant lines from the outdoor unit to indoor units shall be individually insulated.

4. The outdoor unit shall have an accumulator with refrigerant level sensors and controls.

5. The outdoor unit shall have a high pressure safety switch, low pressure safety switch and over-current protection and DC bus protection.

6. The outdoor unit shall have the ability to operate with a maximum height difference of 98 feet for the PUMY-P36NHMU (-BS) & PUMY-P48NHMU (-BS) and 164 feet for the PUMY-P60NKMU (-BS) and have a total refrigerant tubing length of 393 feet for the PUMY-P36NHMU (-BS) & PUMY-P48NHMU (-BS) and 492 feet for the PUMY-P60NKMU (-BS). The greatest length is not to exceed 262 feet between the outdoor unit and the CITY MULTI indoor units and shall not require line size changes nor traps.

7. The outdoor unit shall have rated performance for heat operation at 0°F for the PUMY-P36NHMU (-BS) & PUMY-P48NHMU (-BS) and -4°F for the PUMY-P60NKMU (-BS) ambient temperature without additional low ambient controls.

8. The outdoor unit shall be capable of cooling operation down to 23°F outdoor ambient without additional low ambient controls.

9. The outdoor unit shall have a high efficiency oil separator plus additional logic controls to ensure adequate oil volume in the compressor is maintained.

B. Unit Cabinet:

1. The casing shall be fabricated of galvanized steel, bonderized and finished with a powder coated baked enamel.

C. Fan:

1. The unit shall be furnished with two direct drive, variable speed motors.

2. The fans will be forward curved type blades for quiet operation.

3. The fan motor shall have inherent protection, have permanently lubricated bearings, and be completely variable speed.

4. The fan motor shall be mounted for quiet operation.

5. The fan shall be provided with a raised guard to prevent contact with moving parts.

6. The outdoor unit shall have horizontal discharge airflow.

D. Refrigerant

1. R410A refrigerant shall be required for all S-Series outdoor unit systems.

E. Coil:

1. The outdoor coil shall be of nonferrous construction with lanced or corrugated fins on copper tubing.
2. The coil fins will have a factory applied corrosion resistant blue-fin finish.

3. The coil shall be protected with an integral metal guard.

4. Refrigerant flow from the outdoor unit shall be controlled by means of an inverter driven compressor.

F. Compressor:

1. The compressor shall be a single high performance, inverter driven, modulating capacity scroll compressor.

2. The outdoor unit compressor shall have an inverter to modulate capacity. The capacity shall be completely variable down to 41% of rated capacity for the PUMY-P36NHMU (-BS), 33% for the PUMY-P48NHMU (-BS), and 29% for the PUMY-P60NKMU (-BS).

3. The compressor shall be equipped with an internal thermal overload.

4. The compressor shall be mounted to avoid the transmission of vibration.

G. Electrical:

1. The outdoor unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

2. The unit shall be capable of satisfactory operation within voltage limitations of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)

3. The outdoor unit shall be controlled by integral microprocessors.

4. The control circuit between the indoor units and the outdoor unit shall be 24VDC completed using a 2-conductor, twisted pair, non-polar shielded cable to provide total integration of the system.

3.02 PKFY (Wall Mounted) INDOOR UNIT

A. General:

The PKFY shall be a wall-mounted indoor unit section and shall have a modulating linear expansion device and a flat front. The PKFY shall be used with the R2-Series outdoor unit and BC Controller, Y-Series outdoor unit, or S-Series outdoor unit. The PKFY shall support individual control using M-NET DDC controllers.

B. Indoor Unit

The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

C. Unit Cabinet:

1. All casings, regardless of model size, shall have the same white finish

2. Multi directional drain and refrigerant piping offering four (4) directions for refrigerant piping and two (2) directions for draining shall be standard.

3. There shall be a separate back plate which secures the unit firmly to the wall.

D. Fan:
1. The indoor fan shall be an assembly with one or two line-flow fan(s) direct driven by a single motor.

2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.

3. A manual adjustable guide vane shall be provided with the ability to change the airflow from side to side (left to right).

4. A motorized air sweep louver shall provide an automatic change in airflow by directing the air up and down to provide uniform air distribution.

E. Filter:

1. Return air shall be filtered by means of an easily removable, washable filter.

F. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.

2. The tubing shall have inner grooves for high efficiency heat exchange.

3. All tube joints shall be brazed with phos-copper or silver alloy.

4. The coils shall be pressure tested at the factory.

5. A condensate pan and drain shall be provided under the coil.

6. Both refrigerant lines to the PKFY indoor units shall be insulated in accordance with the installation manual.

G. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz)

H. Controls:

1. This unit shall use controls provided by Mitsubishi Electric Cooling & Heating to perform functions necessary to operate the system. Please refer to Part 4 of this guide specification for details on controllers and other control options.

2. The unit shall be able to control external backup heat.

3. The unit shall have a factory built in receiver for wireless remote control

4. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

5. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.

6. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.
7. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

3.03 PLFY-P**NFMU-ER4 (4-WAY CEILING-RECESSED CASSETTE WITH GRILLE) INDOOR UNIT

A. General:

1. The PLFY-P**NFMU-ER4 shall be a four-way cassette style indoor unit that recesses into the ceiling with a ceiling grille. The indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, an emergency operation function and a test run switch. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory.

B. Unit Cabinet:

1. The cabinet shall be a compact 22-7/16” wide x 22-7/16” deep so it will fit within a standard 24” square suspended ceiling grid.

2. The cabinet panel shall have provisions for a field installed filtered outside air intake.

3. Four-way grille shall be fixed to bottom of cabinet allowing two, three or four-way blow.

C. Fan:

1. The indoor fan shall be an assembly with a turbo fan direct driven by a single motor.

2. The indoor fan shall be statically and dynamically balanced to run on a motor with permanently lubricated bearings.

3. The indoor fan shall consist of three (3) speeds, Low, Mid, and High.

4. The indoor unit shall have an adjustable air outlet system offering 4-way airflow, 3-way airflow, or 2-way airflow.

5. The auto air swing vanes shall be capable of automatically swinging up and down for uniform air distribution.

D. Filter:

1. Return air shall be filtered by means of a long-life washable filter.

E. Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing.

2. The tubing shall have inner grooves for high efficiency heat exchange.

3. All tube joints shall be brazed with phos-copper or silver alloy.

4. The coils shall be pressure tested at the factory.

5. A condensate pan and drain shall be provided under the coil.

6. The unit shall be provided with an integral condensate lift mechanism that will be able to raise drain water 19-3/4” inches above the condensate pan.
7. Both refrigerant lines to the PLFY indoor units shall be insulated in accordance with the installation manual.

F. Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.

2. The system shall be capable of satisfactory operation within voltage limits of 187-228 volts (208V/60Hz) or 207-253 volts (230V/60Hz).

G. Controls:

1. This unit shall use controls provided by Mitsubishi Electric to perform functions necessary to operate the system.

2. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

3. Control board shall include contacts for control of external heat source. External heat may be energized as second stage with 1.8°F – 9.0°F adjustable deadband from set point.

4. Indoor unit shall include no less than four (4) digital inputs capable of being used for customizable control strategies.

5. Indoor unit shall include no less than three (3) digital outputs capable of being used for customizable control strategies.

Part 4 – Controls

4.01 Overview

A. General:

The CITY MULTI Controls Network (CMCN) shall be capable of supporting remote controllers, centralized controllers, an integrated web based interface, graphical user workstation, and system integration to Building Management Systems via BACnet® and LonWorks®.

4.02 Electrical Characteristics

A. General:

The CMCN shall operate at 30VDC. Controller power and communications shall be via a common non-polar communications bus.

B. Wiring:

1. Control wiring shall be installed in a daisy chain configuration from indoor unit to indoor unit, to the BC controller (main and subs, if applicable) and to the outdoor unit. Control wiring to remote controllers shall be run from the indoor unit terminal block to the controller associated with that unit.

2. Control wiring for the Smart ME remote controller shall be from the remote controller to the first associated indoor unit (TB-5) M-NET connection. The Smart ME remote controller shall be assigned an M-NET address.
3. Control wiring for the Simple MA and Wireless MA remote controllers shall be from the remote controller (receiver) to the first associated indoor unit (TB-15) then to the remaining associated indoor units (TB-15) in a daisy chain configuration.

4. Control wiring for centralized controllers shall be installed in a daisy chain configuration from outdoor unit to outdoor unit, to the system controllers (centralized controllers and/or integrated web based interface), to the power supply.

5. The AE-200, AE-50, and EB-50GU centralized controller shall be capable of being networked with other AE-200, AE-50, and EB-50GU centralized controllers for centralized control.

C. Wiring type:

1. Wiring shall be 2-conductor (16 AWG), twisted, stranded, shielded wire as defined by the Diamond System Builder output.

2. Network wiring shall be CAT-5 with RJ-45 connection.

4.03 CITY MULTI Controls Network

The CITY MULTI Controls Network (CMCN) consists of remote controllers, centralized controllers, and/or integrated web based interface communicating over a high-speed communication bus. The CITY MULTI Controls Network shall support operation monitoring, scheduling, occupancy, error email distribution, personal web browsers, tenant billing, online maintenance support, and integration with Building Management Systems (BMS) using either LonWorks® or BACnet® interfaces. The below figure illustrates a sample CMCN System Configuration.

A. CMCN: Remote Controllers  Backlit Simple MA Remote Controller (PAC-YT53CRAU)  

The Backlit Simple MA Remote Controller (PAC-YT53CRAU) shall be capable of controlling up to 16 indoor units (defined as 1 group). The Backlit Simple MA Remote Controller shall be compact in size, approximately 3" x 5" and have limited user functionality. The Backlit Simple MA supports temperature display selection of Fahrenheit or Celsius. The Backlit Simple MA Remote Controller shall allow the user to change on/off, mode (cool, heat, auto (R2/WR2-Series only), dry, setback
Variable Refrigerant Volume Heat Pump Systems

(R2/WR2-Series only) and fan), temperature setting, and fan speed setting and airflow direction. The Backlit Simple MA Remote Controller shall be able to limit the set temperature range from the Backlit Simple MA. The Backlit Simple MA Remote controller shall be capable of night setback control with upper and lower set temperature settings. The room temperature shall be sensed at either the Backlit Simple MA Remote Controller or the Indoor Unit dependent on the indoor unit dipswitch setting. The Backlit Simple MA Remote Controller shall display a four-digit error code in the event of system abnormality/error.

The Backlit Simple MA Remote Controller shall only be used in same group with Wireless MA Remote Controllers (PAR-FL32MA-E / PAR-FA32MA-E) or with other Backlit Simple MA Remote Controllers (PAC-YT53CRAU), with up to two remote controllers per group.

The Backlit Simple MA Remote Controller shall require no addressing. The Backlit Simple MA Remote Controller shall connect using two-wire, stranded, non-polar control wire to TB15 connection terminal on the indoor unit. The Simple MA Remote Controller shall require cross-over wiring for grouping across indoor units.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Operation</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>ON/OFF</strong></td>
<td>Run and stop operation for a single group</td>
<td>Each Group</td>
<td>Each Group</td>
</tr>
<tr>
<td><strong>Operation Mode</strong></td>
<td>Switches between Cool/Drying/Auto/Fan/Heat/Setback. Operation modes vary depending on the air conditioner unit. Auto and Setback mode are available for the R2/WR2-Series only.</td>
<td>Each Group</td>
<td>Each Group</td>
</tr>
<tr>
<td><strong>Temperature Setting</strong></td>
<td>Sets the temperature from 40°F – 95°F depending on operation mode and indoor unit. Separate COOL and HEAT mode set points available depending on central controller and connected mechanical equipment.</td>
<td>Each Group</td>
<td>Each Group</td>
</tr>
<tr>
<td><strong>Fan Speed Setting</strong></td>
<td>Available fan speed settings depending on indoor unit.</td>
<td>Each Group</td>
<td>Each Group</td>
</tr>
<tr>
<td><strong>Air Flow Direction Setting</strong></td>
<td>Air flow direction settings vary depending on the indoor unit model.</td>
<td>Each Group</td>
<td>Each Group</td>
</tr>
<tr>
<td><strong>Permit / Prohibit Local Operation</strong></td>
<td>Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter). *1: Centrally Controlled is displayed on the remote controller for prohibited functions.</td>
<td>N/A</td>
<td>Each Group *1</td>
</tr>
<tr>
<td><strong>Display Indoor Unit Intake Temp</strong></td>
<td>Measures and displays the intake temperature of the indoor unit when the indoor unit is operating.</td>
<td>N/A</td>
<td>Each Group</td>
</tr>
<tr>
<td><strong>Display Backlight</strong></td>
<td>Pressing the button lights up a backlight. The light automatically turns off after a certain period of time. (The brightness settings can be selected from Bright, Dark, and Light off.)</td>
<td>N/A</td>
<td>Each Unit</td>
</tr>
<tr>
<td><strong>Error</strong></td>
<td>When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed</td>
<td>N/A</td>
<td>Each Unit</td>
</tr>
<tr>
<td><strong>Test Run</strong></td>
<td>Operates air conditioner units in test run mode. *2 The display for test run mode will be the same as for normal start/stop (does not display “test run”).</td>
<td>Each Group</td>
<td>Each Group *2</td>
</tr>
<tr>
<td><strong>Ventilation Equipment</strong></td>
<td>Up to 16 indoor units can be connected to an interlocked system that has one LOSSNAY unit.</td>
<td>Each Group</td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Set Temperature Range Limit</strong></td>
<td>Set temperature range limit for cooling, heating, or auto mode.</td>
<td>Each Group</td>
<td>Each Group</td>
</tr>
</tbody>
</table>
A. AE-200 Centralized Controller

The AE-200A Centralized Controller shall be capable of controlling a maximum of two hundred (200) indoor units across multiple CITY MULTI outdoor units with the use of three (3) AE-50A expansion controllers. The AE-200A Centralized Controller shall be approximately 11-5/32” x 7-55/64” x 2-17/32” in size and shall be powered with an integrated 100-240 VAC power supply. The AE-200A Centralized Controller shall support system configuration, daily/weekly scheduling, monitoring of operation status, night setback settings, free contact interlock configuration and malfunction monitoring. When being used alone without the expansion controllers, the AE-200A Centralized Controller shall have five basic operation controls which can be applied to an individual indoor unit, a collection of indoor units (up to 50 indoor units), or all indoor units (collective batch operation). This basic set of operation controls for the AE-200 Centralized Controller shall include on/off, operation mode selection (cool, heat, auto (R2/WR2-Series only), dry, setback (R2/WR2-Series only) and fan), temperature setting, fan speed setting, and airflow direction setting. Since the AE-200A provides centralized control it shall be able to enable or disable operation of local remote controllers. In terms of scheduling, the AE-200A Centralized Controller shall allow the user to define both daily and weekly schedules (up to 24 scheduled events per day) with operations consisting of ON/OFF, mode selection, temperature setting, air flow (vane) direction, fan speed, and permit/prohibit of remote controllers.

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Operation</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>ON/OFF</td>
<td>Run and stop operation.</td>
<td>Each Block,</td>
<td>Each Group, Collective</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Group or Collective</td>
<td></td>
</tr>
<tr>
<td>Operation Mode</td>
<td>Switches between Cool/Dry/Auto/Fan/Heat.</td>
<td>Each Block,</td>
<td>Each Group</td>
</tr>
<tr>
<td></td>
<td>(Group of Lossnay unit: automatic ventilation/vent-</td>
<td>Group or Collective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>heat/interchange/normal ventilation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Operation modes vary depending on the air conditioner unit.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Auto mode is available for the R2/WR2-Series only.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Temperature Setting</td>
<td>Sets the temperature from 57°F – 87°F depending on operation mode and</td>
<td>Each Block,</td>
<td>Each Group</td>
</tr>
<tr>
<td></td>
<td>indoor unit.</td>
<td>Group or Collective</td>
<td></td>
</tr>
<tr>
<td>Fan Speed Setting</td>
<td>Available fan speed settings depending on indoor unit.</td>
<td>Each Block,</td>
<td>Each Group</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Group or Collective</td>
<td></td>
</tr>
<tr>
<td>Air Flow Direction</td>
<td>Air flow direction settings vary depending on the indoor unit</td>
<td>*1 Each Block,</td>
<td>Each Group</td>
</tr>
<tr>
<td>Setting</td>
<td>model.</td>
<td>Group or Collective</td>
<td></td>
</tr>
<tr>
<td></td>
<td>*1. Louver cannot be set.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### AE-200 (Centralized Controller)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Operation</th>
<th>Display</th>
</tr>
</thead>
</table>
| Schedule Operation          | Annual/weekly/today schedule can be set for each group of air conditioning units. Optimized start setting is also available.  
*1. The system follows either the current day, annual schedule, or weekly, which are in the descending order of overriding priority.  
Twenty-four events can be scheduled per day, including ON/OFF, Mode, Temperature Setting, Air Direction, Fan Speed and Operation Prohibition.  
Five types of weekly schedule (seasonal) can be set.  
Settable items depend on the functions that a given air conditioning unit supports. | *2 Each Block, Group or Collective | Each Group         |
| Optimized Start             | Unit starts 5 - 60 minutes before the scheduled time based on the operation data history in order to reach the scheduled temperature at the scheduled time.                                                       | Each Block, Group or Collective | Each Group         |
| Night Setback Setting       | The function helps keep the indoor temperature in the temperature range while the units are stopped and during the time this function is effective.                                                              | Each Group         | Each Group         |
| Permit / Prohibit Local Operation | Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Reset filter).  
*3. Centrally Controlled is displayed on the remote controller for prohibited functions.                                                   | Each Block, Group or Collective | *3 Each Group     |
| Room Temp                   | Displays the room temperature of the group. Space temperature displayed on the indoor unit icon on the touch screen interface.                                                                           | N/A                | Each Group         |
| Error                       | When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed  
*4. When an error occurs, the LED flashes. The operation monitor screen shows the abnormal unit by flashing it. The error monitor screen shows the abnormal unit address, error code and source of detection.  
The error log monitor screen shows the time and date, the abnormal unit address, error code and source of detection. |
| Outdoor Unit Status         | Compressor capacity percentage and system pressure (high and low) pressure (excludes S-Series)                                                                                                             | Each ODU           | Each ODU           |
| Connected Unit Information  | MNET addresses of all connected systems                                                                                                                                                                    | Each IDU, ODU and BC | Each IDU, ODU and BC |
| Ventilation Equipment       | This interlocked system settings can be performed by the master system controller.  
When setting the interlocked system, use the ventilation switch the free plan LOSSNAY settings between “Hi”, “Low” and “Stop”.  
When setting a group of only free plan LOSSNAY units, you can switch between “Normal ventilation”, “Interchange ventilation” and “Automatic ventilation”. | Each Group         | Each Group         |
| Multiple Language           | Other than English, the following language can be chosen. Spanish, French, Japanese, Dutch, Italian, Russian, Chinese, and Portuguese are available.                                                        | N/A                | Collective        |
### AE-200 (Centralized Controller)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Operation</th>
<th>Display</th>
</tr>
</thead>
<tbody>
<tr>
<td>External Input</td>
<td>By using accessory cables you can set and monitor the following.</td>
<td>*5 Collective</td>
<td>*5 Collective</td>
</tr>
<tr>
<td>/ Output</td>
<td>Input</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>By level: “Batch start/stop”, “Batch emergency stop”</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>By pulse: “batch start/stop”, “Enable/disable remote controller”</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Output: “start/stop”, “error/Normal”</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>*5. Requires the external I/O cables (PAC-YG10HA-E) sold separately.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

All AE-200A Centralized Controllers shall be equipped with two RJ-45 Ethernet ports to support interconnection with a network PC via a closed/direct Local Area Network (LAN) or to a network switch for IP communication to up to three AE-50A expansion controllers for display of up to two hundred (200) indoor units on the main AE-200A interface.

The AE-200A Centralized Controller shall be capable of performing initial settings via the high-resolution, backlit, color touch panel on the controller or via a PC browser using the initial settings.

Standard software functions shall be available so that the building manager can securely log into each AE-200A via the PC’s web browser to support operation monitoring, scheduling, error email, interlocking and online maintenance diagnostics. Additional optional software functions of personal browser for PCs and MACs and Tenant Billing shall be available but are not included. The Tenant Billing function shall require TG-2000 Integrated System software in conjunction with the Centralized Controllers.

#### B. AE-50A Expansion Controller

The AE-50A Expansion Controller shall serve as a standalone centralized controller or as an expansion module to the AE-200A Centralized Controller for the purpose of adding up to 50 indoor units to either the main touch screen interface of the AE-200A. Up to three (3) AE-50A expansion controllers can be connected to the AE-200A via a local IP network (and their IP addresses assigned on the AE-200A) to the AE-200A to allow for up to two hundred (200) indoor units to be monitored and controlled from the AE-200A interface.

The AE-50A expansion controllers have all of the same capabilities to monitor and control their associated indoor units as the features specified above. Even when connected to the AE-200A and configured to display their units on the main controller, the individual indoor units connected to the AE-50A can still be monitored and controlled from the interface of the AE-50. The last command entered will take precedence, whether at the wall controller, the AE-50A or the AE-200A Centralized Controller.

4.11 Power Supply (PAC-SC51KUA)

The power supply shall supply 24VDC (TB3) for the AE-200/AE-50/EB-50GU centralized controller and 30VDC (TB2) voltage for the central control transmission.
SECTION 23 81 43
PACKAGED AIR CONDITIONING UNITS (DX)

1 GENERAL

1.1 Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 Division-23 Basic Mechanical Materials and Methods sections apply to work of this section.

1.3 Refer to other Division-23 sections for testing, adjusting, and balancing of air conditioning units (RTUs).

1.4 Approval Submittals:

1.4.1 Product Data: Submit manufacturer's technical product data, including dimensions, ratings, electrical characteristics, weight, capacities, materials of construction, and installation instructions.

1.4.1.1 Packaged air conditioning units

1.4.1.2 Vibration Isolation

1.5 O&M Data Submittals: Submit manufacturer's maintenance data including parts lists. Include these data, a copy of approval submittals, product data, and wiring diagrams in O&M manual.

2 PRODUCTS

2.1 Quality Assurance:

2.1.1 Provide units tested by UL, ARL or ETL.

2.1.2 Construct refrigeration system in accordance with ASHRAE 15 (ANSI B 9.1) "Safety Code for Mechanical Refrigeration".

2.1.3 Test and rate ACUs in accordance with the applicable ARI standards and provide certified rating seal. Sound test and rate units in accordance with ARI 270.

2.1.4 Provide units with an EER that meets the Florida Energy Efficiency Code and the schedules on the drawings.

2.1.5 Acceptable Manufacturers: Subject to compliance with requirements provide units by: Carrier, Trane, Daikin, Lennox, or approved equal.

2.2 General:

2.2.1 Units shall be factory-assembled, wired and tested. All controls shall be factory-adjusted and preset to the design conditions.

2.2.2 Casings: Construct of heavy gauge steel (or aluminum) formed panels rigidly reinforced and braced. Each unit shall be provided with removable panels to permit the unit (including fans and compressors) to be properly maintained and serviced. Entire casing shall be painted with factory-applied finish. Casing for outdoor units shall be provided with weatherproof construction with all seams bolted. Provide stainless steel hardware. Units shall be sealed to minimize leakage.

2.2.3 Base: The base pan of the entire unit shall be sealed against moisture leakage after fabrication.

2.3 Condensing Section:
2.3.1 Condenser Fans and Drives: Fan shall be of rustproof construction: hot-dipped galvanized steel, stainless steel or aluminum. Unit shall have a variable speed motor suitable for the duty indicated. Provide a close fretwork galvanized steel or non-ferrous fan and guard. Motors shall be the permanently lubricated type, resiliently mounted.

2.3.2 Condenser Coil: Construct of copper tubes and copper aluminum fins. Provide inlet guard to protect condenser fins. Provide seacoast or heresite coating on the condenser coil.

2.3.3 Compressor: Shall be scroll, hermetic, or semi-hermetic reciprocating design for R410a refrigerant with vibration isolation. Each compressor shall have separate refrigerant circuit. Motors shall be ball bearing, high starting torque, low starting current type for compressor service. Compressors shall not produce objectionable noise or vibration inside the building. Compressors shall have five (5) year warranty.

2.3.4 Service Valves: Provide for high and low pressure readings.

2.4 Evaporator Section:

2.4.1 Interior of unit shall be thermally and acoustically insulated with minimum R=4.2 insulation. Provide aluminum inner liner. Provide removable panels to permit the unit to be properly serviced and maintained.

2.4.2 The evaporator shall include centrifugal fan, fan motor, direct drive vee belt drive, cast-iron sheaves, vari-pitch fan motor sheave, and lubricated bearings. Motors shall be high efficiency type as per Division-23, Basic Mechanical Materials and Methods section, "Motors". Provide cooling coils constructed of copper tubes and copper aluminum fins. Filters and coils shall be selected for a maximum face velocity of 500 fpm. Provide thermal expansion valve, sight glass, refrigerant drier, strainer, controls and other necessary devices for a completely automatic unit.

2.4.3 Each unit shall be equipped with sloped IAQ drain pans under the entire evaporator coil to prevent condensate carry-over.

2.5 Electric Heater Section:

2.5.1 Provide electric heating coils controlled by one or more magnetic contactors. Three phase coils shall be wired for balanced current in each wire, if possible. Furnish and install necessary overheating and air flow controls to meet the requirements of the National Electric Code. Provide built-in air flow switch and heater interlock relay.

2.5.2 Heaters shall be factory mounted and wired with all required fuses and contactors to provide single point connection.

2.6 Unit Controls:

2.6.1 All safety and operational controls shall be factory wired.

2.6.2 Safety and Operational Control Features:

Internal compressor overtemperature protection.
Crankcase heaters.
Individual motor overcurrent protection.
High pressure cutout.
Low pressure cutout.
Anti-recycle timer (5 minute)
Timer-type defrost control.

Liquid line solenoid.
Hot gas bypass.

2.6.3 Room thermostat shall be low voltage, remote-mounted with sub-base and thermometer for controlling
heating and cooling cycles. The fan selector shall include "AUTO-ON" controls. The system selector shall include "OFF-COOL-HEAT-EM HT" controls. Provide automatic changeover thermostats with fan that run continuously. The room thermostats shall be manually adjustable by occupants and shall indicate setting and temperature in degrees Fahrenheit. Provide two heating stages.

2.6.4 Outdoor air thermostat shall energize electric heat below 35° F on call for heating by second stage of room thermostat.

2.6.5 Emergency heat switch shall allow operation of all electric heat.

2.7 Basic Vibration Isolation: Provide vibration isolation products complying with Division-23 section "Vibration Isolation" and the following list:

2.7.1 Bases and Frames: Type BF4 BF5

3 EXECUTION

3.1 Installation: Install in accordance with producer's printed instructions. Anchor housing to curb with cadmium plated self-tapping screws, lag screws, or bolts, as directed by curb construction. Secure unit to withstand 125 mph wind velocity. The curb shall be installed by the roofing contractor.

3.2 Cleaning: Clean tar and all other soil from housing exterior. Leave ready for Division 7, Caulking Work.

3.3 Brush out fins on all coils.

3.4 Condensate Drain: Pipe trapped copper condensate drain (full size of unit outlet) to the nearest floor/roof system drain or as shown on the drawings. Refer to Division-23 section "Insulation" for pipe insulation.

3.5 Construction Filters: Provide 2" thick filters in all units during construction. After construction (but prior to the test and balance being performed) install clean final filters.

3.6 Startup: Check entire assembly for correctness of installation, alignment, and control sequencing. Start all component parts in proper sequence. Make all adjustments required to insure proper smooth quiet operation.

END OF SECTION
PART 1 - GENERAL

1.1 SUMMARY

The Electrical General Requirements are supplementing and applicable to Division 26 Sections and shall apply to all phases of work specified herein, shown on the Drawings, or required to provide a complete installation of electrical systems. Section 26 is sub-divided for convenience only.

A. This Section includes the following:

1. Job Conditions
2. Regulatory Requirements
3. Electrical equipment coordination and installation.
4. Submittals, Operating and Maintenance instructions and As-built drawings.
5. Common electrical installation requirements.
6. Warranty of work.

1.2 JOB CONDITIONS:

A. Site Inspections: Before submitting proposals, each bidder should visit the site and fully familiarize himself with all job conditions and shall be fully informed as to the extent of his work. No consideration will be given after bid opening date for alleged misunderstanding as to the requirements of work involved in connecting to the utilities or as to requirements of materials to be furnished. The contractor shall contact the utility prior to bid and make appropriate provisions in such bid as required by the utility for the utility’s routing and connection.

B. Scheduled Interruptions: Planned interruptions of utilities service, to any facility affected by this contract, shall be carefully planned and approved by Architect at least ten (10) days in advance of the requested interruption. The Contractor shall not interrupt services until the Architect has granted specific approval. The request shall indicate services to be affected, date and time of interruption and duration of outage. Request for interruption of service will not be approved until all equipment and materials required for the completion of that particular phase of work are on the job site. The work may have to be scheduled after normal working hours.

C. Accidental Interruptions: All excavation and/or remodeling work required shall be performed with care so as not to interrupt other existing services (water, gas, electrical, sewer, sprinklers, etc.). If accidental utility interruption resulting from work performed by the Contractor occurs, service shall be immediately restored to its original condition without delay, by and at the expense of the Contractor, using skilled workmen of the trade required.

1.3 REGULATORY REQUIREMENTS:

A. Permits, Fees, and Inspections: This Contractor shall secure and pay for all permits, and inspections required on work performed under this section of the Specifications. He shall assume full responsibility for all assessments and taxes necessary for the completion and acceptance of the work. The Owner will arrange for utility power including any impact fees.

B. Applicable Standards and Codes: The electrical installation shall comply with all applicable building codes; local, state, and federal ordinances. In case of a discrepancy among these applicable regulatory codes and ordinances, the most stringent requirement shall govern. The Contractor shall notify the Architect in writing of any such discrepancy. Should the Contractor perform any work that does not comply with the applicable regulatory codes and ordinances he shall bear all cost arising in
correcting the deficiencies. Application standards and codes shall include all local ordinances, all state laws, and the applicable requirements of the following:

1. American National Standards Institute - ANSI
2. National Electrical Manufacturer’s Association - NEMA
8. Underwriters' Laboratories, Inc. – UL

C. Drawings and Specifications: The drawings and these specifications are complementary each to the other. What is called for by one shall be as binding as if called for by both. Omissions from the drawings and specifications of details of work which are evidently necessary to carry out the intent of the drawings and specifications, or which are customarily performed, shall not relieve the Contractor from performing such work. In any case of discrepancy in the figures or catalog numbers, the matter shall be submitted to the Architect, who shall promptly make a determination in writing. Any adjustment by the Contractor shall be at the Contractor's own risk and expense. Electrical drawings are diagrammatic only. Do not scale these drawings. All equipment shall be installed in accordance with manufacturer's recommendations and any conflicting data shall be verified before bidding.

D. The Contractor shall after completion of the work, furnish the Architect a certificate of final inspection and approval from the applicable local inspection department. The Contractor shall also make necessary changes to plans and specifications to meet code standards at no additional cost to the Owner.

1.4 CONNECTION TO EXISTING UTILITIES:

A. All utility work shall be coordinated with and approved by the local providing utility. Permission for all utility outages shall be requested a minimum of (14) days in advance, unless an emergency arises. Explicit detail shall be shown for all connections to existing utilities. The applicable utility company must approve both the location and the method of the proposed connection.

B. The contractor coordinate procedure to and shall pay for all electric energy consumption during construction as part of the project.

C. The contractor shall include the electric utility connection fee in the bid unless specifically directed by Owner not to do so. If, prior to bid, the electric utility connection fee is unknown, the Contractor shall include $25,000 as a line item in the bid for each service. Once the utility connection fee is known, if the utility connection fee is less than $25,000, the balance shall be removed from the Contractor's total contract price.

1.5 COOPERATION:

A. Interfacing with Other Crafts: It shall be the responsibility of the Contractor to cooperate and coordinate with all other crafts working on this project. This Contractor shall do all cutting, trenching, backfill and structural removals to permit entry of the electrical system components. The General Contractor shall do all patching and finishing.

B. Equipment Furnished Under Other Sections: This Contractor shall furnish and install, complete electrical roughing-in and connections to all equipment furnished under other sections and indicate on drawings. This includes all outlets as shown on mechanical and electrical drawings. All such equipment shall be set in place as work of other sections.

C. Heating and Air Conditioning:
1. The Contractor shall furnish all branch circuit wiring to motors and control panels or centers including disconnects, receptacles, switches, and appurtenances to which the system at the units may be connected, to provide a complete system of wiring for power. Control equipment and control circuit wiring is specified in the Mechanical Section.

2. Control devices to be included in the branch circuit, except those furnished integrals with the equipment, will be delivered by the Heating and Air Conditioning Contractor and installed by the Electrical Contractor.

1.6 WORKMANSHIP:

All work shall be executed in a neat and substantial manner by skilled workman, well qualified, and regularly engaged in the type of work required. Substandard work shall be removed and replaced by the Contractor at no cost to the Owner.

1.7 APPROVAL OF MATERIALS AND EQUIPMENT:

A. Prior-Submittals: The Contractor shall base his proposal on the materials specified herein and on the drawings. Reference to a particular product by manufacturer, trade name, or catalog number establishes the quality standards of material and equipment required for this installation and is not intended to exclude products equal in quality and similar design. The Specifying Engineer reserves the sole right to decide the equality of materials proposed for use in lieu of these specified. It shall be the Contractor's responsibility to furnish the information and data sufficient to establish the quality and utility of the items in question, including furnishing of samples if required.

B. Submittals:

1. Submittals: The Contractor shall submit a list of equipment proposed for installation. Catalog data and shop drawings on all proposed systems and their components shall be submitted. Where substitutions alter the design or space requirements, the Contractor shall defray all items of cost for the revised design and construction including costs to all allied trades involved. Provide six (6) copies of submittals and shop drawings as a minimum unless the General Conditions requires a greater number of copies. In lieu of paper copies, the Contractor may submit the submittals in PDF format.
   a. Submittals Schedule: Submittals shall be submitted within thirty (30) days after the contract is awarded. It is not the responsibility of the Engineer to expedite the review of submittals if the contractor has not adequately prepared the submittals in a time efficient manner. The contractor bears all the responsibility for the added time requirements of resubmittals.
   b. Identification: Place a permanent label or title block on each submittal for identification. Each major section of submittals such as power equipment, lighting equipment, fire alarm, etc., shall be secured together in a booklet or stapled with a covering index. The different parts of the submittal shall describe which Specification Section it is referenced. The covering index shall list the following information:
      1) Project name and date
      2) Name, address, and phone number of General contractor and project manager.
      3) Name, address, and phone number of Sub-contractor and project manager.
      4) Supplier of equipment with phone number and person responsible for this project.
      5) Index of each item covered in submittal and model number.
      6) Any deviation from contract documents shall be specifically noted on submittal cover index and specifically identified with highlighting, encircling, or boldly on specific submittal sheet.
   c. The submittal shall not be in individual parts per each Specification Section but be combined as a part of a major section such as power equipment, lighting equipment, fire alarm, methods, etc.
d. Resubmittals: The Specifying Engineer will participate in two resubmittal reviews. After the second resubmittal review, the Engineer shall not review the submittal until the Contractor provides $1,000 to the Engineer to perform each additional required resubmittal review. Make resubmittals in same form and number of copies as initial submittal.
   1) Include previous submittal review comments.
   2) For each item being resubmitted, include previous review comment and explain how resubmitted item meets the criteria of the previous review comment.

2. Electrical and Mechanical/Plumbing/Fire Protection Equipment Coordination:

The electrical power equipment submittals shall be accompanied by a letter verifying coordination of electrical services for all mechanical, plumbing, and fire protection equipment requiring power. The letter shall follow the format listed below.

To: __________________________________________
   (General Contractor)

Re: _______________________________________
   (Project name and location)

We the undersigned subcontractors certify that we have coordinated the electrical requirements for mechanical, plumbing, and fire protection sprinkler equipment as evidenced by the coordination chart listed herein.

<table>
<thead>
<tr>
<th>Item</th>
<th>Load Full Load</th>
<th>1 Phase or 3 Phase</th>
<th>Number of Electrical Connections</th>
<th>Maximum Overcurrent Protection</th>
<th>Minimum Overcurrent Protection</th>
<th>Breaker Proposed</th>
<th>Circuit Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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</tr>
</tbody>
</table>

The above list details all required electrical connections for mechanical equipment.

Signed: __________________________________
For: _____________________________________
Mechanical Subcontractor

The above list details all required electrical connections for plumbing equipment.

Signed: __________________________________
For: _____________________________________
Plumbing Subcontractor

The above list of equipment has been reviewed and the required connections are being provided. (Any exceptions or request for direction shall be listed here)

Signed: __________________________________
For: _____________________________________
Electrical Subcontractor

1.8 PRODUCT DELIVERY, STORAGE AND HANDLING
260500 - 4 ELECTRICAL GENERAL REQUIREMENTS
A. Protection: Take necessary precautions to protect all material, equipment, apparatus and work from damage. Failure to do so to the satisfaction of the Architect will be sufficient cause for the rejection of the material, equipment or work in question. Contractor is responsible for the safety and good condition of the materials installed until final acceptance by the owner.

B. Cleaning: Conduit openings shall be capped or plugged during installation. Fixtures and equipment shall be tightly covered and protected against dirt, moisture, chemical and mechanical injury. At the completion of the work the fixtures, material and equipment shall be thoroughly cleaned and delivered in condition satisfactory to the Architect.

1.9 TESTING AND BALANCING:

Make tests that may be required by the Owner or the Architect in connection with the operation of the electrical system in the buildings. Balance all single-phase loads connected to all panelboards in the buildings to insure approximate equal divisions of these loads on the main secondary power supply serving the buildings. All tests shall be made in accordance with the latest standards of the IEEE and the NEC. The installation shall be tested as defined in the 26 specifications. Contractor shall perform circuit continuity and operational tests on all equipment furnished or connected by Contractor. The tests shall be made in the presence of the Architect or his representative. The Contractor shall notify the Architect at least twenty-four (24) hours in advance of tests. The Contractor shall provide all testing equipment and all costs shall be borne by him. Written reports shall be made of all tests and shall be made available at the Pre-Final Inspection. All faults shall be corrected immediately.

A. A letter shall be written giving the following:

1. Measured amps on each phase of each panel.
2. Resistance to ground of each new grounding electrode.
3. Measured voltage phase to phase and phase to neutral at each panel.
4. Ground continuity and polarity instrument used.

1.10 OPERATING AND MAINTENANCE INSTRUCTIONS/AS BUILT DRAWINGS:

A. Four (4) complete sets of instructions containing the manufacturer’s Operating and Maintenance (O&M) instructions for each piece of equipment shall be furnished to the Owner. Each set shall be permanently bound and shall have a hard cover. One complete set shall be furnished at the time that the test procedure is submitted, and remaining sets shall be furnished before the Contract is completed. Flysheets shall be placed before instructions covering each subject. The instruction sheets shall be approximately 8-1/2” by 11” with large sheets of Drawings folded in. The instructions shall include information for major pieces of equipment and systems. In addition, a CD shall be provided to the Owner with the O&M Manuals and Drawings contained therein.

B. Upon completion of the work and at the time designated, the services of one project engineer shall be provided by the Contractor to instruct the representative of the Owner in the operation and maintenance of the systems.

C. This Contractor shall provide as-built Drawings at the completion of the job. Drawings shall show all significant changes in equipment, wiring, routing, location, etc. All underground conduit routing shall be accurately indicated with locations dimensioned. As-built drawings shall be submitted for review as red-lined on a field hard copy. After review by the Architect, the Contractor will be given digital AutoCAD files and shall make revisions and resubmit final on disk.

D. All signals, communications, data, control, dimming systems, etc. shall be included in the As-Built drawings. Where electrical drawings contain a large number of items that prevent easy discernment of the As-Built system, enlarged details or other graphic methods shall be used to clarify the identification required for As-Builds usage.
E. As-Built drawings shall include the following information:

1. Stub-out locations dimensioned from permanent building lines.
2. Routing of all main feeders and identified as under slab, in slab, above ceiling, etc. also for lighting and power branch circuits the number of conductors shall be included, and for feeders and motor branch circuits the number, size, and insulation of conductors shall be included.
3. Corrected panel board and equipment schedules.
4. Corrected circuit numbers as they appear on the panel board directories.
5. Corrected motor horsepower and full load amperes.
6. Location of major distribution open junction boxes with 2" conduit and over.
7. Location of all underground raceways or duct banks dimensioned from easily identified points with depth indicated from BFG (below finished grade) and by elevation in feet.

7.11 GUARANTEE AND SERVICE:

A. Upon completion of all tests and acceptance, the Contractor shall furnish the Owner a written guarantee covering the electrical work done for a period of one (1) year from date of acceptance. Guarantee includes equipment capacity and performance ratings specified without excessive noise levels. Upon notice from the Architect or the Owner, the Contractor shall, during the guarantee period, rectify and replace any defective material or workmanship and repair any damage caused thereby without additional cost.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1-2015.

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.

END OF SECTION
SECTION 260519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Copper building wire rated 600 V or less.
   2. Aluminum building wire rated 600 V or less.
   3. Metal-clad cable, Type MC, rated 600 V or less.
   4. Fire-alarm wire and cable.
   5. Connectors, splices, and terminations rated 600 V and less.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: Indicate type, use, location, and termination locations.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 COPPER BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn copper current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Alpha Wire Company.
   2. General Cable Technologies Corporation.
   3. Okonite Company (The).

C. Standards:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
   2. RoHS compliant.
   3. Conductor and Cable Marking: Comply with wire and cable marking according to UL's "Wire and Cable Marking and Application Guide."

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D. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

E. Conductor Insulation – All types may not be indicated below, coordinate with Drawings and intended uses:

1. Type NM: Comply with UL 83 and UL 719.
2. Type RHH and Type RHW-2: Comply with UL 44.
3. Type USE-2 and Type SE: Comply with UL 854.
4. Type THHN and Type THWN-2: Comply with UL 83.
5. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
6. Type XHHW-2: Comply with UL 44.

2.2 ALUMINUM BUILDING WIRE

A. Description: Flexible, insulated and uninsulated, drawn aluminum current-carrying conductor with an overall insulation layer or jacket, or both, rated 600 V or less.

B. Allowed Use Locations: Aluminum conductors may only be used on feeder or distribution circuits larger than 100A. The Drawings typically indicate all conductor sizes in copper. The contractor shall provide a cross reference table for engineer approval prior to any conductor to be substituted with an aluminum conductor.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Alpha Wire Company.
2. General Cable Technologies Corporation.
3. Okonite Company (The).

D. Standards:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
2. RoHS compliant.
3. Conductor and Cable Marking: Comply with wire and cable marking according to UL’s "Wire and Cable Marking and Application Guide."

E. Conductors: Aluminum, complying with ASTM B800 and ASTM B801.

F. Conductor Insulation – All types may not be indicated below, coordinate with Drawings and intended uses:

1. Type NM: Comply with UL 83 and UL 719.
2. Type RHH and Type RHW-2: Comply with UL 44.
3. Type USE-2 and Type SE: Comply with UL 854.
4. Type THHN and Type THWN-2: Comply with UL 83.
5. Type THW and Type THW-2: Comply with NEMA WC-70/ICEA S-95-658 and UL 83.
6. Type XHHW-2: Comply with UL 44.
2.3 METAL-CLAD CABLE, TYPE MC

A. Description: A factory assembly of one or more current-carrying insulated conductors in an overall metallic sheath.

B. Allowed Use Locations: Metal-clad cable, Type MC shall only be used in walls from end of circuit devices (receptacles or switches) up to junction box above ceiling for homerun circuit or light fixture. Homerun circuit shall not be in Type MC cable. Wiring between devices within walls are allowed to be in Type MC cable.

C. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. General Cable Technologies Corporation.
   2. Okonite Company (The).

D. Standards:
   1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.
   2. Comply with UL 1569.
   3. RoHS compliant.
   4. Conductor and Cable Marking: Comply with wire and cable marking according to UL’s “Wire and Cable Marking and Application Guide.”

E. Circuits:

F. Conductors: Copper, complying with ASTM B3 for bare annealed copper and with ASTM B8 for stranded conductors.

G. Ground Conductor: Insulated.

H. Conductor Insulation:
   1. Type TFN/THHN/THWN-2: Comply with UL 83.
   2. Type XHHW-2: Comply with UL 44.

I. Armor: Steel, interlocked.

J. Jacket: PVC applied over armor.

2.4 FIRE-ALARM WIRE AND CABLE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. General Cable Technologies Corporation.
   2. Okonite Company (The).
B. General Wire and Cable Requirements: NRTL listed and labeled as complying with NFPA 70, Article 760.

C. Signaling Line Circuits: Twisted, shielded pair, not less than No. 16 AWG.

D. Non-Power-Limited Circuits: Solid-copper conductors with 600-V rated, 75 deg C, color-coded insulation, and complying with requirements in UL 2196 for a two-hour rating.

1. Low-Voltage Circuits: No. 16 AWG, minimum, in pathway.
2. Line-Voltage Circuits: No. 12 AWG, minimum, in pathway.

2.5 CONNECTORS AND SPLICES

A. Description: Factory-fabricated connectors, splices, and lugs of size, ampacity rating, material, type, and class for application and service indicated; listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Jacketed Cable Connectors: For steel and aluminum jacketed cables, zinc die-cast with set screws, designed to connect conductors specified in this Section.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper for feeders smaller than No. 3 AWG; copper or aluminum for feeders No. 3 AWG and larger. Conductors shall be solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.


3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN/THWN-2, single conductors in raceway.

B. Exposed Feeders: Type THHN/THWN-2, single conductors in raceway.

C. Feeders Concealed in Ceilings and Crawlspace: Type THHN/THWN-2, single conductors in raceway.

D. Feeders Concealed in Walls and Partitions: Type THHN/THWN-2, single conductors in raceway.

E. Feeders Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

F. Feeders in Cable Tray: Type THHN/THWN-2, single conductors in raceway or Type RHW-2/USE-2 if exterior located.
G. Exposed Branch Circuits, Including in Crawlspace: Type XHHW-2, single conductors in raceway.

H. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN-2, single conductors in raceway or Metal-clad cable, Type MC.

I. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type XHHW-2, single conductors in raceway.

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 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 as required by other Specification sections.

3.4 INSTALLATION OF FIRE-ALARM WIRING

A. Comply with NECA 1 and NFPA 72.

B. Wiring Method: Install wiring in metal pathway according to Section 280528 "Pathways for Electronic Safety and Security."

1. Install plenum cable in environmental airspaces, including plenum ceilings.
2. Fire-alarm circuits and equipment control wiring associated with fire-alarm system shall be installed in a dedicated pathway system. This system shall not be used for any other wire or cable.

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 fire-alarm system to terminal blocks. Mark each terminal according to 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 another 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. Wiring to Remote Alarm Transmitting Device: 1-inch conduit between the fire-alarm control panel and the transmitter. Install number of conductors and electrical supervision for connecting wiring as needed to suit monitoring function.

3.5 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-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches of slack.

D. Prior to conduit/conductor routing to outlets, contractor shall request final verification of locations. Outlets shall be allowed to be moved 10 feet prior to installation with no cost change.

E. Comply with requirements in accompanying Section on Fire Alarm Systems for connecting, terminating, and identifying wires and cables.

3.6 IDENTIFICATION

A. Identify and color-code conductors and cables according to requirements in accompanying Sections in this book of Specifications.

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 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 accompanying Sections in this book of Specifications.

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to requirements in accompanying Sections in this book of Specifications.

END OF SECTION
SECTION 260526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY
A. Section includes grounding and bonding systems and equipment, plus the following special applications:
   1. Foundation steel electrodes.

1.2 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS
A. Field quality-control reports.

1.4 QUALITY ASSURANCE
A. Testing Agency Qualifications: Certified by NETA.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION
A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. Comply with UL 467 for grounding and bonding materials and equipment.

2.2 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Burndy; Part of Hubbell Electrical Systems.
   2. ERICO; a brand of nVent.
   3. Galvan Industries, Inc.; Electrical Products Division, LLC.
   4. O-Z/Gedney; a brand of Emerson Industrial Automation.
   5. Thomas & Betts Corporation; A Member of the ABB Group.
2.3 CONDUCTORS

B. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

C. Bare Copper Conductors:
   4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch in diameter.
   5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.
   6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
   7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

D. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches in cross section, with 9/32-inch holes spaced 1-1/8 inches apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V and shall be Lexan or PVC, impulse tested at 5000 V.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

C. Bus-Bar Connectors: Compression type, copper or copper alloy, with two wire terminals.

D. Beam Clamps: Mechanical type, terminal, ground wire access from four directions, with dual, tin-plated or silicon bronze bolts.

E. Cable-to-Cable Connectors: Compression type, copper or copper alloy.

F. Cable Tray Ground Clamp: Mechanical type, zinc-plated malleable iron.

G. Conduit Hubs: Mechanical type, terminal with threaded hub.

E. Ground Rod Clamps: Mechanical type, copper or copper alloy, terminal with hex head bolt.

F. Lay-in Lug Connector: Mechanical type, copper rated for direct burial terminal with set screw.

G. Signal Reference Grid Clamp: Mechanical type, stamped-steel terminal with hex head screw.

H. Straps: Solid copper, copper lugs. Rated for 600 A.

I. U-Bolt Clamps: Mechanical type, copper or copper alloy, terminal listed for direct burial.

J. Water Pipe Clamps:
1. Mechanical type, two pieces with stainless-steel bolts.
   b. Listed for direct burial.

2. U-bolt type with malleable-iron clamp and copper ground connector rated for direct burial.

2.5 GROUNDING ELECTRODES

K. Ground Rods: Copper-clad steel, sectional type; 3/4 inch by 10 feet.

L. Ground Plates: 1/4 inch thick, hot-dip galvanized.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 10 AWG and smaller, and stranded conductors for No. 8 AWG and larger unless otherwise indicated.

B. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.
   1. Install bus horizontally, on insulated spacers 2 inches minimum from wall, 6 inches above finished floor unless otherwise indicated.
   2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

C. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
   3. Connections to Ground Rods at Test Wells: Bolted connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.
C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

E. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches below finished floor or final grade unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.
   2. Use exothermic welds for all below-grade connections.
   3. For grounding electrode system, 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, and connect to the service grounding electrode conductor.

D. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

E. Grounding and Bonding for Piping:
1. Metal Water Service Pipe: Install 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; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

F. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

G. Grounding for Steel Building Structure: Install a driven ground rod at base of each corner column and at intermediate exterior columns at distances not more than 60 feet apart.

H. Connections: Make connections so possibility of galvanic action or electrolysis is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact are galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer in 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.

3.5 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.
3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

   a. Measure ground resistance no fewer than two full days after last trace of precipitation and without 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.
   b. Perform tests by fall-of-potential method according to IEEE 81.
4. Prepare dimensioned 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.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 10 ohms.
2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.
3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 3 ohms.
4. Power Distribution Units or Panelboards Serving Electronic Equipment: 3 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION
SECTION 260529
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. Section Includes:
   1. Steel slotted support systems.
   2. Aluminum slotted support systems.
   3. Conduit and cable support devices.
   4. Support for conductors in vertical conduit.
   5. Structural steel for fabricated supports and restraints.
   6. Mounting, anchoring, and attachment components, including powder-actuated fasteners, mechanical expansion anchors, concrete inserts, clamps, through bolts, toggle bolts, and hanger rods.
   7. Fabricated metal equipment support assemblies.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
      a. Slotted support systems, hardware, and accessories.
      b. Clamps.
      c. Hangers.
      d. Sockets.
      e. Eye nuts.
      f. Fasteners.
      g. Anchors.
      h. Saddles.
      i. Brackets.
   2. Include rated capacities and furnished specialties and accessories.
PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Preformed steel channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Allied Tube & Conduit; a part of Atkore International.
   b. B-line, an Eaton business.
   c. Thomas & Betts Corporation; A Member of the ABB Group.
   d. Unistrut; Part of Atkore International.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
4. Channel Width: Selected for applicable load criteria.
5. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
6. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Aluminum Slotted Support Systems: Extruded-aluminum channels and angles with minimum 13/32-inch-diameter holes at a maximum of 8 inches o.c. in at least one surface.

1. Manufacturers: Subject to compliance with requirements, undefined:
   a. Cooper Industries, Inc.
   b. Thomas & Betts Corporation; A Member of the ABB Group.
   c. Unistrut; Part of Atkore International.

2. Standard: Comply with MFMA-4 factory-fabricated components for field assembly.
5. Channel Width: Selected for applicable load criteria.
6. Painted Coatings: Manufacturer’s standard painted coating applied according to MFMA-4.
7. Protect finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

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 nonarmored 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 made of 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. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, undefined:
      1) Hilti, Inc.
      2) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      3) MKT Fastening, LLC.

2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
   a. Manufacturers: Subject to compliance with requirements, undefined:
      1) B-line, an Eaton business.
      2) Hilti, Inc.
      3) ITW Ramset/Red Head; Illinois Tool Works, Inc.
      4) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units are similar to MSS Type 18 units and comply with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58 units are suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM F 3125/F3125M, Grade A325.


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 Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with the following standards for application and installation requirements of hangers and supports, except where requirements on Drawings or in this Section are stricter:
   1) NECA 1.
   2) NECA 101
   3) NECA 102.

B. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping materials and installation for penetrations through fire-rated walls, ceilings, and assemblies.

C. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."
D. Maximum Support Spacing and Minimum Hanger Rod Size for Raceways: Space supports for EMT, IMC, and RMC as required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

E. 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 two-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings, and for fastening raceways to trapeze supports.

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 IMC and RMC may be supported by openings through structure members, according to 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. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick.
6. To Steel: Beam clamps (MSS SP-58, Type 19, 21, 23, 25, or 27), complying with MSS SP-69.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid the need for reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "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 CONCRETE BASES

A. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000 psi, 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete."

C. Anchor equipment to concrete base as follows:

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor bolts to elevations required for proper attachment to supported equipment.
3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

END OF SECTION
SECTION 260533
RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Metal conduits and fittings.
   2. Nonmetallic conduits and fittings.
   3. Metal wireways and auxiliary gutters.
   5. Handholes and boxes for exterior underground cabling.
B. Related Requirements:
   1. "Penetration Firestopping" for firestopping at conduit and box entrances.
   3. "Pathways for Communications Systems" for conduits, wireways, surface pathways, innerduct, boxes, faceplate adapters, enclosures, cabinets, and handholes serving communications systems.

1.3 DEFINITIONS
A. ARC: Aluminum rigid conduit.
B. GRC: Galvanized rigid steel conduit.
C. IMC: Intermediate metal conduit.

1.4 ACTION SUBMITTALS
A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.
B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.
1.5 INFORMATIONAL SUBMITTALS

PART 2 - PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

A. Metal Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit; a part of Atkore International.
   b. O-Z/Gedney; a brand of Emerson Industrial Automation.
   c. Southwire Company.
   d. Thomas & Betts Corporation; A Member of the ABB Group.
   e. Wheatland Tube Company.

2. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. GRC: Comply with ANSI C80.1 and UL 6.

4. IMC: Comply with ANSI C80.6 and UL 1242.

5. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   a. Comply with NEMA RN 1.
   b. Coating Thickness: 0.040 inch, minimum.

6. EMT: Comply with ANSI C80.3 and UL 797.

7. FMC: Comply with UL 1; zinc-coated steel.

8. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

B. Metal Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allied Tube & Conduit; a part of Atkore International.
   b. O-Z/Gedney; a brand of Emerson Industrial Automation.
   c. Southwire Company.
   d. Thomas & Betts Corporation; A Member of the ABB Group.
   e. Wheatland Tube Company.

2. Comply with NEMA FB 1 and UL 514B.

3. Listing and Labeling: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

4. Fittings, General: Listed and labeled for type of conduit, location, and use.

5. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.

6. Fittings for EMT:
   a. Material: Steel.
   b. Type: Setscrew or compression.

7. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
8. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.

C. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS AND FITTINGS

A. Nonmetallic Conduit:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. RACO; Hubbell.
   b. Thomas & Betts Corporation; A Member of the ABB Group.
   c. United Fiberglass.

2. Listing and Labeling: Nonmetallic conduit shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

3. Fiberglass:
   b. Comply with UL 2515 for aboveground raceways.
   c. Comply with UL 2420 for belowground raceways.

4. ENT: Comply with NEMA TC 13 and UL 1653.

5. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

6. LFNC: Comply with UL 1660.

B. Nonmetallic Fittings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. RACO; Hubbell.
   b. Thomas & Betts Corporation; A Member of the ABB Group.
   c. United Fiberglass.

2. Fittings, General: Listed and labeled for type of conduit, location, and use.

3. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.
   a. Fittings for LFNC: Comply with UL 514B.

4. Solvents and Adhesives: As recommended by conduit manufacturer.

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. B-line, an Eaton business.
2. Hoffman; a brand of nVent.
3. MonoSystems, Inc.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 Type 3R unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, 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. Wireway Covers: Hinged type Screw-cover type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

2. EGS/Appleton Electric.
3. Hoffman; a brand of nVent.
5. O-Z/Gedney; a brand of Emerson Industrial Automation.
6. RACO; Hubbell.
7. Thomas & Betts Corporation; A Member of the ABB Group.
8. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

E. Nonmetallic Floor Boxes: Nonadjustable, rectangular or round, as indicated on Drawings.

1. Listing and Labeling: Nonmetallic floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep.

J. Gangable boxes are allowed.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
   2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

L. Cabinets:
   1. NEMA 250, Type 1 Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.
   6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.5 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:
   1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.
   2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Armorcast Products Company.
      b. Oldcastle Enclosure Solutions.
   2. Standard: Comply with SCTE 77.
   3. Configuration: Designed for flush burial with closed bottom unless otherwise indicated.
   4. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.
   5. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
   6. Cover Legend: Molded lettering, "ELECTRIC."
   7. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.
PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed Conduit: GRC IMC.
   2. Concealed Conduit, Aboveground: GRC IMC EMT RNC, Type EPC-40-PVC.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:
   1. Exposed, Not Subject to Physical Damage: EMT.
   2. Exposed, Not Subject to Severe Physical Damage: EMT.
   3. Exposed and Subject to Severe Physical Damage: IMC. Raceway locations include the following:
      a. Loading dock.
      b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.
      c. Mechanical rooms.
      d. Gymnasiums.
   4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   6. Damp or Wet Locations: IMC.
   7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 1/2-inch trade size.

D. 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. Comply with NEMA FB 2.10.
   2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.
   3. EMT: Use setscrew or compression, 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.

E. 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.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.
H. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.

3.2 INSTALLATION

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

B. 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.

C. Do not install raceways or electrical items on any "explosion-relief" walls or rotating equipment.

D. Do not fasten conduits onto the bottom side of a metal deck roof.

E. 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.

F. Complete raceway installation before starting conductor installation.

G. Arrange stub-ups so curved portions of bends are not visible above finished slab.

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. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

J. Conceal conduit within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

K. Support conduit within 12 inches of enclosures to which attached.

L. Raceways Embedded in Slabs:

1. Run conduit larger than 1-inch trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot intervals.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Arrange raceways to keep a minimum of 2 inches of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

5. Change from ENT to IMC before rising above floor.

M. Stub-Ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
N. 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.

O. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

P. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

Q. 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.

R. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

S. 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.

T. 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.

U. 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. Cap underground raceways designated as spare above grade alongside raceways in use.

V. Surface Raceways:
   1. Install surface raceway with a minimum 2-inch radius control at bend points.
   2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

W. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with 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 according to NFPA 70.

X. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where an underground service raceway enters a building or structure.
   3. Conduit extending from interior to exterior of building.
   4. Conduit extending into pressurized duct and equipment.
   5. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.
   6. Where otherwise required by NFPA 70.

Y. Comply with manufacturer's written instructions for solvent welding RNC and fittings.
Z. 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 and EMT 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 manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

AA. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semirecessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

   1. Use LFMC in damp or wet locations subject to severe physical damage.
   2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

BB. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

CC. 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. Prepare block surfaces to provide a flat surface for airtight connection between box and cover plate or supported equipment and box.

DD. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

EE. Locate boxes so that cover or plate will not span different building finishes.

FF. 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.

GG. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

HH. Set metal floor boxes level and flush with finished floor surface.

II. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.
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 Section 312000 "Earth Moving" for pipe less than 6 inches in nominal diameter.
2. Install backfill as specified in Section 312000 "Earth Moving."
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 Section 312000 "Earth Moving."
4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.
5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.
   a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches of concrete for a minimum of 12 inches on each side of the coupling.
   b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.
6. Warning Planks: Bury warning planks approximately 12 inches above direct-buried conduits but a minimum of 6 inches below grade. Align planks along centerline of conduit.
7. Underground Warning Tape: Comply with requirements in Section 260533 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES 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 with bottom below frost line
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 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 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 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION
SECTION 260544

SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
   2. Sleeve-seal systems.
   5. Silicone sealants.

B. Related Requirements:
   1. "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.
2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Advance Products & Systems, Inc.
   b. Metraflex Company (The).
   c. Pipeline Seal and Insulator, Inc.

2. Sealing Elements: EPDM rubber 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.

4. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

1. Manufacturers: Subject to compliance with requirements, provide products by the following:
   a. Emerson
   b. Innerlynx, Eaton Crouse-Hinds, a Cooper Industries Company
   c. Link-Seal, GPT an EnPro Industries Company
   d. Metraflex

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.


C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2. Sealant shall have a VOC content of 50 g/L or less.
B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.
B. Comply with NEMA VE 2 for cable tray and cable penetrations.
C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:
   1. Interior Penetrations of Non-Fire-Rated Walls and Floors:
      a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."
      b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.
   2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
   3. Size pipe sleeves to provide 1/4-inch annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed.
   4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. Deburr after cutting.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:
   1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.
   2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.
B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION
SECTION 260553
IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Color and legend requirements for raceways, conductors, and warning labels and signs.
      2. Labels.
      4. Tapes and stencils.
      5. Tags.
      7. Cable ties.
      9. Fasteners for labels and signs.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
   B. Samples: For each type of label and sign to illustrate composition, size, colors, lettering style,
      mounting provisions, and graphic features of identification products.
   C. Delegated-Design Submittal: For arc-flash hazard study.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   B. Comply with NFPA 70.
   D. Comply with ANSI Z535.4 for safety signs and labels.
E. Comply with NFPA 70E and "Arc-Flash Hazard Analysis" requirements for arc-flash warning labels.

F. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

G. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 COLOR AND LEGEND REQUIREMENTS

A. Raceways and Cables Carrying Circuits at 600 V or Less:
   1. Black letters on an white field.
   2. Legend: Indicate voltage and system or service type.

B. Color-Coding for Phase-[and Voltage-Level] Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.
   1. Color shall be factory applied or field applied for sizes larger than No. 8 AWG if authorities having jurisdiction permit.
   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.
   5. Color for Equipment Grounds: Bare copper, Green, or Green with a yellow stripe.

C. Warning Label Colors:
   1. Identify system voltage with black letters on an orange background.

D. Warning labels and signs 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."

E. Equipment Identification Labels:
1. Black letters on a white field.

2.3 LABELS

A. Vinyl Wraparound Labels: Preprinted, flexible labels laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing label ends.

B. Snap-around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameters sized to suit diameter and that stay in place by gripping action.

C. Self-Adhesive Wraparound Labels: Preprinted, 3-mil thick, vinyl flexible label with acrylic pressure-sensitive adhesive.
   1. Self-Lamination: Clear; UV-, weather- and chemical-resistant; self-laminating, protective shield over the legend. Labels sized such that the clear shield overlaps the entire printed legend.
   2. Marker for Labels: Machine-printed, permanent, waterproof, black ink recommended by printer manufacturer.

D. Self-Adhesive Labels: Vinyl, thermal, transfer-printed, 3.5-mil thick, multicolor, weather- and UV-resistant, pressure-sensitive adhesive labels, configured for intended use and location.
   1. Minimum Nominal Size:
      a. 1-1/2 by 6 inches for raceway and conductors.
      b. 3-1/2 by 5 inches for equipment.
      c. As required by authorities having jurisdiction.

2.4 BANDS AND TUBES

A. Snap-around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameters sized to suit diameter and that stay in place by gripping action.

B. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tubes with machine-printed identification labels, sized to suit diameters of and shrunk to fit firmly around item being identified. Full shrink recovery occurs at a maximum of 200 deg F. Comply with UL 224.

2.5 TAPES AND STENCILS

A. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

B. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; not less than 3 mils thick by 1 to 2 inches wide; compounded for outdoor use.

C. Tape and Stencil: 4-inch wide black stripes on 10-inch centers placed diagonally over orange background and is 12 inches wide. Stop stripes at legends.

D. Floor Marking Tape: 2-inch wide, 5-mil pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.
E. Underground-Line Warning Tape:

1. Tape:
   a. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications lines.
   b. Printing on tape shall be permanent and shall not be damaged by burial operations.
   c. Tape material and ink shall be chemically inert and not subject to degradation when exposed to acids, alkalis, and other destructive substances commonly found in soils.

2. Color and Printing:
   b. Inscriptions for Red-Colored Tapes: "ELECTRIC LINE, HIGH VOLTAGE"
   c. Inscriptions for Orange-Colored Tapes: "TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE".

3. Description:
   a. Detectable three-layer laminate, consisting of a printed pigmented polyolefin film, a solid aluminum-foil core, and a clear protective film that allows inspection of the continuity of the conductive core; bright colored, compounded for direct-burial service.
   b. Width: 3 inches.
   c. Overall Thickness: 5 mils.
   d. Foil Core Thickness: 0.35 mil.
   e. Weight: 28 lb/1000 sq. ft.
   f. Tensile according to ASTM D882: 70 lbf and 4600 psi.

F. Stenciled Legend: In nonfading, waterproof, black ink or paint. Minimum letter height shall be 1 inch.

2.6 SIGNS

A. Baked-Enamel Signs:
   1. Preprinted aluminum signs, high-intensity reflective, punched or drilled for fasteners, with colors, legend, and size required for application.
   2. 1/4-inch grommets in corners for mounting.

B. Metal-Backed Butyrate Signs:
   1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs, with 0.0396-inch galvanized-steel backing, punched and drilled for fasteners, and with colors, legend, and size required for application.
   2. 1/4-inch grommets in corners for mounting.
   3. Nominal Size: 10 by 14 inches.

C. Laminated Acrylic or Melamine Plastic Signs:
   1. Engraved legend.
2. Thickness:
   a. For signs up to 20 sq. in., minimum 1/16 inch thick.
   b. For signs larger than 20 sq. in., 1/8 inch thick.
   c. Engraved legend with black letters on white face
   d. Punched or drilled for mechanical fasteners with 1/4-inch grommets in corners for mounting.
   e. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.7 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
   3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, and Type 6/6 nylon.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 12,000 psi (82.7 MPa).
   3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, and self-locking.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength at 73 Deg F (23 Deg C) according to ASTM D638: 7000 psi (48.2 MPa).
   3. UL 94 Flame Rating: 94V-0.
   4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).
   5. Color: Black.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Retain paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify and coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and operation and maintenance manual. Use consistent designations throughout Project.

B. Install identifying devices before installing acoustical ceilings and similar concealment.

C. Verify identity of each item before installing identification products.

D. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and operation and maintenance manual.

E. Apply identification devices to surfaces that require finish after completing finish work.

F. Install signs with approved legend to facilitate proper identification, operation, and maintenance of electrical systems and connected items.

G. Self-Adhesive Identification Products: Before applying electrical identification products, clean substrates of substances that could impair bond, using materials and methods recommended by manufacturer of identification product.

H. System Identification for Raceways and Cables under 600 V: Identification shall completely encircle cable or conduit. Place identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.

I. System Identification for Raceways and Cables over 600 V: Identification shall completely encircle cable or conduit. Place adjacent identification of two-color markings in contact, side by side.
   1. Secure tight to surface of conductor, cable, or raceway.


K. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and/or any emergency operations.

L. Elevated Components: Increase sizes of labels, signs, and letters to those appropriate for viewing from the floor.

M. Accessible Fittings for Raceways: Identify the covers of each junction and pull box of the following systems with the wiring system legend and system voltage. System legends shall be as follows:
   1. "EMERGENCY POWER"
2. "POWER"
3. "UPS"
4. "LIFE SAFETY"

N. Vinyl Wraparound Labels:
   1. Secure tight to surface at a location with high visibility and accessibility.
   2. Attach labels that are not self-adhesive type with clear vinyl tape, with adhesive appropriate to the location and substrate.

O. Snap-around Labels: Secure tight to surface at a location with high visibility and accessibility.

P. Self-Adhesive Wraparound Labels: Secure tight to surface of raceway or cable at a location with high visibility and accessibility.

Q. Self-Adhesive Labels:
   1. On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and operation and maintenance manual.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch (13-mm) high letters on 1-1/2-inch (38-mm) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

R. Snap-around Color-Coding Bands: Secure tight to surface at a location with high visibility and accessibility.

S. Heat-Shrink, Preprinted Tubes: Secure tight to surface at a location with high visibility and accessibility.

T. Marker Tapes: Secure tight to surface at a location with high visibility and accessibility.

U. Self-Adhesive Vinyl Tape: Secure tight to surface at a location with high visibility and accessibility.

   1. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding.

V. Tape and Stencil: Comply with requirements in painting Sections for surface preparation and paint application.

W. Floor Marking Tape: Apply stripes to finished surfaces following manufacturer's written instructions.

X. Underground Line Warning Tape:
   1. During backfilling of trenches, install continuous underground-line warning tape directly above cable or raceway at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.
   2. Install underground-line warning tape for direct-buried cables and cables in raceways.
Y. Write-on Tags:
   1. Place in a location with high visibility and accessibility.

Z. Baked-Enamel Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

AA. Metal-Backed Butyrate Signs:
   1. Attach signs that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

BB. Laminated Acrylic or Melamine Plastic Signs:
   1. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.
   2. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on minimum 1-1/2-inch- (38-mm-) high sign; where two lines of text are required, use signs minimum 2 inches (50 mm) high.

CC. Cable Ties: General purpose, for attaching tags, except as listed below:
   1. Outdoors: UV-stabilized nylon.
   2. In Spaces Handling Environmental Air: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

A. Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment. Install access doors or panels to provide view of identifying devices.

B. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, pull points, and locations of high visibility. Identify by system and circuit designation.

C. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits, More Than 30 A and 120 V to Ground: Identify with self-adhesive raceway labels.
   1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.
D. Accessible Fittings for Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive labels containing the wiring system legend and system voltage. System legends shall be as follows:

1. "EMERGENCY POWER"
2. "POWER"
3. "UPS"
4. "LIFE SAFETY"

E. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use self-adhesive wraparound labels to identify the phase.

1. Locate identification at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

F. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use write-on tags self-adhesive wraparound labels with the conductor or cable designation, origin, and destination.

G. Control-Circuit Conductor Termination Identification: For identification at terminations, provide heat-shrink preprinted tubes with the conductor designation.

H. Auxiliary Electrical Systems Conductor Identification: Self-adhesive vinyl tape that is uniform and consistent with system used by manufacturer for factory-installed connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

I. Locations of Underground Lines: Underground-line warning tape for power, lighting, communication, and control wiring and optical-fiber cable.

J. Workspace Indication: Apply floor marking tape and stencil] to finished surfaces. Show working clearances in the direction of access to live parts. Workspace shall comply with NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

K. Instructional Signs: Self-adhesive labels, including the color code for grounded and ungrounded conductors.

L. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Baked-enamel warning signs.

1. Apply to exterior of door, cover, or other access.
2. For 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.

N. Operating Instruction Signs: Laminated acrylic or melamine plastic signs.

O. Emergency Operating Instruction Signs: Laminated acrylic or melamine plastic signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and other emergency operations.

P. Equipment Identification Labels:

   1. Indoor Equipment: Laminated acrylic or melamine plastic sign.
   2. Outdoor Equipment: Laminated acrylic or melamine sign.

END OF SECTION
SECTION 260573.19
ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance
      and the incident energy to which personnel could be exposed during work on or near electrical
      equipment.

1.3 DEFINITIONS
   A. Existing to Remain: Existing items of construction that are not to be removed and that are not
      otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.
   B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and
      the capability to adjust devices and conduct testing indicated and that is a member company of
      NETA.
   C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the
      course of an electric circuit or system of circuits and the component devices or parts used therein.
   D. Power System Analysis Software Developer: An entity that commercially develops, maintains,
      and distributes computer software used for power system studies.
   E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and
      documenting recommendations, licensed in the state where Project is located.
   F. Protective Device: A device that senses when an abnormal current flow exists and then removes
      the affected portion from the system.
   G. SCCR: Short-circuit current rating.
   H. Service: The conductors and equipment for delivering electric energy from the serving utility to
      the wiring system of the premises served.

1.4 ACTION SUBMITTALS
   A. Product Data: For computer software program to be used for studies.
B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals shall be in digital form:

1. Arc-flash study input data, including completed computer program input data sheets.
2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.
3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 QUALITY ASSURANCE

A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. EasyPower.
2. SKM Systems Analysis, Inc.

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.
2. Conductor types, sizes, and lengths.
3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.
4. Motor and generator designations and kVA ratings.
5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.
D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Study Output Data: As specified in "Short-Circuit Study Output Reports" Paragraph in "Short-Circuit Study Report Contents" Article in "Short-Circuit Studies."

F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in "Coordination Studies."

G. Arc-Flash Study Output Reports:
   1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:
      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.

H. Incident Energy and Flash Protection Boundary Calculations:
   1. Arcing fault magnitude.
   2. Protective device clearing time.
   3. Duration of arc.
   5. Restricted approach boundary.
   7. Working distance.
   8. Incident energy.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch self-adhesive equipment label for each work location included in the analysis.

B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:
   1. Location designation.
   2. Nominal voltage.
   3. Protection boundaries.
      a. Arc-flash boundary.
      b. Restricted approach boundary.
      c. Limited approach boundary.
4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.
7. Working distance.
8. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Calculate maximum and minimum contributions of fault-current size.

1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.
3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.
4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.

C. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

D. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.

E. Calculate the limited, restricted, and prohibited approach boundaries for each location.

F. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors shall not be considered beyond three to five cycles.
2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).
G. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.
2. When the line terminals of the circuit breaker are separate from the work location.

H. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on one-line diagram on Drawings. Call discrepancies to Architect's attention.
2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.
3. For existing equipment, whether or not relocated, obtain required electrical distribution system data by field investigation and surveys conducted by qualified technicians and engineers.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.
2. Obtain electrical power utility impedance or available short circuit current at the service.
3. Power sources and ties.
4. Short-circuit current at each system bus (three phase and line to ground).
5. Voltage level at each bus.
6. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.
7. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.
8. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.
9. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.
10. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.
11. Motor horsepower and NEMA MG 1 code letter designation.
12. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).
13. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).
3.4  LABELING

A. Apply one arc-flash label on the front cover of each section of the equipment for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below shall have an arc-flash label applied to it:

1. Motor-control center.
2. Low-voltage switchboard.
3. Switchgear.
4. Medium-voltage switch.
5. Medium voltage transformers
6. Low voltage transformers. Exclude transformers with high voltage side 240 V or less and less than 125 kVA.
7. Panelboard and safety switch over 250 V.
8. Applicable panelboard and safety switch under 250 V.

C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.

1. Indicate arc-flash energy.
2. Indicate protection level required.

3.5  APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

END OF SECTION
SECTION 260923
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 01 Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section Includes:
   1. Time switches.
   2. Photoelectric switches.
   3. Indoor occupancy and vacancy sensors.
   4. Switchbox-mounted occupancy sensors.
   5. High-bay occupancy sensors.

B. Related Requirements:
   1. Section 262726 "Wiring Devices" for wall-box dimmers, non-networkable wall-switch occupancy sensors, and manual light switches.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings:
   1. Show installation details for the following:
      a. Occupancy sensors.
      b. Vacancy sensors.
   2. Interconnection diagrams showing field-installed wiring.
   3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS
A. Sample Warranty: For manufacturer's warranties.
1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of lighting control device to include in operation and maintenance manuals.

1.6 WARRANTY

A. Manufacturer’s Warranty: Manufacturer and Installer agree to repair or replace lighting control devices that fail(s) in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Faulty operation of lighting control software.
   b. Faulty operation of lighting control devices.

2. Warranty Period: Two year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 ELECTROMECHANICAL DIAL-TIME SWITCHES

A. Electromechanical-Dial Time Switches: Comply with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Contact Configuration: SPST.
3. Contact Rating: 30-A inductive or resistive, 277-V ac.
4. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.
5. Astronomic time dial.
7. Skip-a-day mode.
8. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES, SOLID STATE, FLEXIBLE MOUNTING

A. Description: Solid state, with SPST dry contacts rated for 4432 VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A, and compatible with ballasts and LED lamps.

1. Listed and labeled as defined in NFPA 70, by a agency NRTL, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen-second minimum, to prevent false operation.
5. Mounting: Twist lock complies with ANSI C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure from same source and manufacturer as switch.
2.3 INDOOR OCCUPANCY AND VACANCY SENSORS

A. General Requirements for Sensors:

2. Dual technology.
3. Separate power pack.
4. Hardwired connection to switch.
5. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
6. Operation:
   a. Occupancy Sensor: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   b. Vacancy Sensor: Unless otherwise indicated, lights are manually turned on and sensor turns lights off when the room is unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
   c. Combination Sensor: Unless otherwise indicated, sensor shall be programmed to turn lights on when coverage area is occupied and turn them off when unoccupied, or to turn off lights that have been manually turned on; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

7. Sensor Output: Sensor is powered from the power pack.
8. Power: Line voltage
9. Power Pack: Dry contacts rated for 20-A LED load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
10. Mounting:
    a. Sensor: Suitable for mounting in any position on a standard outlet box.
    b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
    c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

11. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
12. Bypass Switch: Override the "on" function in case of sensor failure.
13. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

B. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Separate for each sensing technology.
2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch (2440-mm)-high ceiling.

4. Detection Coverage (Room, Wall Mounted): Detect occupancy anywhere within a 180-degree pattern centered on the sensor over an area of [1000 square feet (110 square meters)] [2000 square feet (220 square meters)] [3000 square feet (330 square meters)] when mounted 48 inches (1200 mm) above finished floor.

2.4 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. General Requirements for Sensors: Automatic-wall-switch occupancy sensor with manual on-off switch, suitable for mounting in a single gang switchbox, hardwired connection.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Occupancy Sensor Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn lights off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.

3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).

4. Switch Rating: Not less than 800-VA LED load at 120 V, 1200-VA LED load at 277 V, and 800-W incandescent.

B. Wall-Switch Sensor Tag WS1:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of [900 sq. ft. (84 sq. m)] [2100 sq. ft (196 sq. m)].

2. Sensing Technology: Dual technology - PIR and ultrasonic.

3. Switch Type: SP, field-selectable automatic "on," or manual "on," automatic "off."


5. Voltage: Match the circuit voltage.

6. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.

7. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

9. Color: Architect approved

10. Faceplate: Color matched to switch.

2.5 HIGH-BAY OCCUPANCY SENSORS

A. Description: Solid-state unit. The unit is designed to operate with the lamp and driver indicated.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Operation: Turn lights on when coverage area is occupied, and to half-power when unoccupied; with a time delay for turning lights to half-power that is adjustable over a minimum range of 1 to 16 minutes.


4. Operating Ambient Conditions: 32 to 149 deg F (0 to 65 deg C).

5. Mounting: Threaded pipe.

6. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

7. Detector Technology: PIR.
B. Detector Coverage: PIR lenses, suitable for mounting heights from 12 to 50 feet (3.7 to 15.2 m).

2.6 LIGHTING CONTACTORS

A. Description: Electrically operated and mechanically held, combination-type lighting contactors with nonfused disconnect, complying with NEMA ICS 2 and UL 508.

1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less THD of normal load current).
2. Fault Current Withstand Rating: Equal to or exceeding the available fault current at the point of installation.
3. Enclosure: Comply with NEMA 250.
4. Provide with control and pilot devices as indicated on Drawings, matching the NEMA type specified for the enclosure.

2.7 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 22 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine lighting control devices before installation. Reject lighting control devices that are wet, moisture damaged, or mold damaged.

B. Examine walls and ceilings for suitable conditions where lighting control devices will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 SENSOR INSTALLATION

A. Comply with NECA 1.

B. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
C. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3.3 CONTACTOR INSTALLATION

A. Comply with NECA 1.

3.4 WIRING INSTALLATION

A. Comply with NECA 1.

B. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

C. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

D. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.

E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.5 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.
2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.6 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. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Lighting control devices will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.
3.7 ADJUSTING

1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

3.8 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.16 "Addressable-Luminaire Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION
SECTION 262213
LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions in other Specification Sections, apply to this Section.

1.2 SUMMARY
A. Section includes distribution, dry-type transformers with a nominal primary and secondary rating of 600 V and less, with capacities up to 1500 kVA.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type and size of transformer.
   2. Include rated nameplate data, capacities, weights, dimensions, minimum clearances, installed devices and features, and performance for each type and size of transformer.
B. Shop Drawings:
   1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Vibration Isolation Base Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
   3. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS
A. Qualification Data: For testing agency.
B. Source quality-control reports.
C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For transformers to include in emergency, operation, and maintenance manuals.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Inspection: On receipt, inspect for and note any shipping damage to packaging and transformer.

   1. If manufacturer packaging is removed for inspection, and transformer will be stored after inspection, re-package transformer using original or new packaging materials that provide protection equivalent to manufacturer's packaging.

B. Storage: Store in a warm, dry, and temperature-stable location in original shipping packaging.

C. Temporary Heating: Apply temporary heat according to manufacturer's written instructions within the enclosure of each ventilated-type unit, throughout periods during which equipment is not energized and when transformer is not in a space that is continuously under normal control of temperature and humidity.

D. Handling: Follow manufacturer's instructions for lifting and transporting transformers.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Square D, a division of Schneider Electric
   2. G.E., a division of ABB
   4. Eaton Corporation, Cutler-Hammer Products

B. Source Limitations: Obtain each transformer type from single source from single manufacturer.

2.2 GENERAL TRANSFORMER REQUIREMENTS

A. Description: Factory-assembled and -tested, air-cooled units for 60-Hz service.

B. Comply with NFPA 70.

   1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

C. Transformers Rated 15 kVA and Larger:

   1. Comply with 10 CFR 431 (DOE 2016) efficiency levels.
   2. Marked as compliant with DOE 2016 efficiency levels by an NRTL.

D. Shipping Restraints: Paint or otherwise color-code bolts, wedges, blocks, and other restraints that are to be removed after installation and before energizing. Use fluorescent colors that are easily identifiable inside the transformer enclosure.
2.3 DISTRIBUTION TRANSFORMERS

A. Comply with NFPA 70, and list and label as complying with UL 1561.

B. Cores: Electrical grade, non-aging silicon steel with high permeability and low hysteresis losses.
   1. One leg per phase.
   2. Core volume shall allow efficient transformer operation at 10 percent above the nominal tap voltage.
   3. Grounded to enclosure.

C. Coils: Continuous windings without splices except for taps.
   1. Coil Material: Copper.
   2. Internal Coil Connections: Brazed or pressure type.

D. Encapsulation: Transformers smaller than 30 kVA shall have core and coils completely resin encapsulated.

E. Enclosure: Ventilated.
   1. NEMA 250, Type as noted on Drawings: Core and coil shall be encapsulated within resin compound to seal out moisture and air.
   2. KVA Ratings: Based on convection cooling only and not relying on auxiliary fans.
   3. Wiring Compartment: Sized for conduit entry and wiring installation.
   4. Finish: Comply with NEMA 250.
      a. Finish Color: ANSI 49 or ANSI 61 gray weather-resistant enamel.

F. Taps for Transformers 25 kVA and Larger: Two 2.5 percent taps above and two 2.5 percent taps below normal full capacity.

G. Insulation Class, Smaller Than 30 kVA: 180 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

H. Insulation Class, 30 kVA and Larger: 220 deg C, UL-component-recognized insulation system with a maximum of 115 deg C rise above 40 deg C ambient temperature.

I. Grounding: Provide ground-bar kit or a ground bar installed on the inside of the transformer enclosure.

J. Wall Brackets: Manufacturer's standard brackets.

2.4 IDENTIFICATION

A. Nameplates: Engraved, laminated-acrylic or melamine plastic signs for each distribution transformer, mounted with corrosion-resistant screws. Nameplates and label products are specified in Section 260558 “Identification for Electrical Systems.”
2.5 SOURCE QUALITY CONTROL

A. Test and inspect transformers according to IEEE C57.12.01 and IEEE C57.12.91.

1. Resistance measurements of all windings at rated voltage connections and at all tap connections.
2. Ratio tests at rated voltage connections and at all tap connections.
3. Phase relation and polarity tests at rated voltage connections.
4. No load losses, and excitation current and rated voltage at rated voltage connections.
5. Impedance and load losses at rated current and rated frequency at rated voltage connections.
6. Applied and induced tensile tests.
7. Regulation and efficiency at rated load and voltage.
8. Insulation-Resistance Tests:
   a. High-voltage to ground.
   b. Low-voltage to ground.
   c. High-voltage to low-voltage.
9. Temperature tests.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions for compliance with enclosure- and ambient-temperature requirements for each transformer.

B. Verify that field measurements are as needed to maintain working clearances required by NFPA 70 and manufacturer's written instructions.

C. Examine walls, floors, roofs, and concrete bases for suitable mounting conditions where transformers will be installed.

D. Verify that ground connections are in place and requirements in "Grounding and Bonding for Electrical Systems" have been met. Maximum ground resistance shall be 5 ohms at location of transformer.

E. Environment: Enclosures shall be rated for the environment in which they are located. Covers for NEMA 250, Type 4X enclosures shall not cause accessibility problems.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall-mounted transformers level and plumb with wall brackets fabricated by transformer manufacturer.
1. Coordinate installation of wall-mounted and structure-hanging supports with actual transformer provided.

B. Install transformers level and plumb on a concrete base with vibration-dampening supports. Locate transformers away from corners and not parallel to adjacent wall surface.

C. Construct concrete bases according to "Cast-in-Place Concrete" and anchor floor-mounted transformers according to manufacturer's written instructions and requirements in "Hangers and Supports for Electrical Systems."

1. Coordinate size and location of concrete bases with actual transformer provided. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified with concrete.

D. Secure transformer to concrete base according to manufacturer's written instructions.

E. Secure covers to enclosure and tighten all bolts to manufacturer-recommended torques to reduce noise generation.

F. Remove shipping bolts, blocking, and wedges.

3.3 CONNECTIONS

A. Ground equipment according to "Grounding and Bonding for Electrical Systems."

B. Connect wiring according to "Low-Voltage Electrical Power 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-486B.

D. Provide flexible connections at all conduit and conductor terminations and supports to eliminate sound and vibration transmission to the building structure.

3.4 FIELD QUALITY CONTROL

A. Small (Up to 167-kVA Single-Phase or 500-kVA Three-Phase) Dry-Type Transformer Field Tests:

1. Visual and Mechanical Inspection.
   a. Inspect physical and mechanical condition.
   b. Inspect anchorage, alignment, and grounding.
   c. Verify that resilient mounts are free and that any shipping brackets have been removed.
   d. Verify the unit is clean.
   e. Perform specific inspections and mechanical tests recommended by manufacturer.
   f. Verify that as-left tap connections are as specified.
   g. Verify the presence of surge arresters and that their ratings are as specified.
2. Electrical Tests:
   
a. Measure resistance at each winding, tap, and bolted connection.
   
b. Perform insulation-resistance tests winding-to-winding and each winding-to-ground. Apply voltage according to manufacturer's published data. In the absence of manufacturer's published data, comply with NETA ATS, Table 100.5. Calculate polarization index: the value of the index shall not be less than 1.0.
   
c. Perform turns-ratio tests at all tap positions. Test results shall not deviate by more than one-half percent from either the adjacent coils or the calculated ratio. If test fails, replace the transformer.
   
d. Verify correct secondary voltage, phase-to-phase and phase-to-neutral, after energization and prior to loading.

B. Remove and replace units that do not pass tests or inspections and retest as specified above.

C. Infrared Scanning: Two months after Substantial Completion, perform an infrared scan of transformer connections.
   
   1. Use an infrared-scanning device designed to measure temperature or detect significant deviations from normal values. Provide documentation of device calibration.
   
   2. Perform two follow-up infrared scans of transformers, one at four months and the other at 11 months after Substantial Completion.
   
   3. Prepare a certified report identifying transformer checked and describing results of scanning. Include notation of deficiencies detected, remedial action taken, and scanning observations after remedial action.

D. Test Labeling: On completion of satisfactory testing of each unit, attach a dated and signed "Satisfactory Test" label to tested component.

3.5 ADJUSTING

A. Record transformer secondary voltage at each unit for at least 48 hours of typical occupancy period. Adjust transformer taps to provide optimum voltage conditions at secondary terminals. Optimum is defined as not exceeding nameplate voltage plus 5 percent and not being lower than nameplate voltage minus 3 percent at maximum load conditions. Submit recording and tap settings as test results.

B. Output Settings Report: Prepare a written report recording output voltages and tap settings.

3.6 CLEANING

A. Vacuum dirt and debris; do not use compressed air to assist in cleaning.

END OF SECTION
SECTION 262416
PANELBOARDS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Distribution panelboards.
   2. Lighting and appliance branch-circuit panelboards.

1.2 DEFINITIONS
A. MCCB: Molded-case circuit breaker.
B. SPD: Surge protective device.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of panelboard.
B. Shop Drawings: For each panelboard and related equipment.
   1. Include dimensioned plans, elevations, sections, and details.
   2. Detail enclosure types including mounting and anchorage, environmental protection, knockouts, corner treatments, covers and doors, gaskets, hinges, and locks.
   3. Detail bus configuration, current, and voltage ratings.
   4. Short-circuit current rating of panelboards and overcurrent protective devices.
   5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   6. Include wiring diagrams for power, signal, and control wiring.
   7. Key interlock scheme drawing and sequence of operations.
   8. Include time-current coordination curves for each type and rating of overcurrent protective device included in panelboards.

1.4 INFORMATIONAL SUBMITTALS
A. Panelboard schedules for installation in panelboards.

1.5 CLOSEOUT SUBMITTALS
A. Operation and maintenance data.
1.6 WARRANTY

A. Manufacturer’s Warranty: Manufacturer agrees to repair or replace panelboards that fail in materials or workmanship within specified warranty period.

1. Panelboard Warranty Period: 18 months from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANELBOARDS COMMON 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. Comply with NEMA PB 1.

C. Comply with NFPA 70.

D. Enclosures: Flush and/or Surface-mounted, as indicated on Drawings, dead-front cabinets.

1. Rated for environmental conditions at installed location.
   a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
   b. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

2. Height: 84 inches (2.13 m) maximum.

3. Hinged Front Cover: Entire front trim hinged to box and with standard door within hinged trim cover. Trims shall cover all live parts and shall have no exposed hardware.

E. Phase, Neutral, and Ground Buses: Tin-plated aluminum.

F. Conductor Connectors: Suitable for use with conductor material and sizes.

2. Main and Neutral Lugs: Mechanical type, with a lug on the neutral bar for each pole in the panelboard.
3. Ground Lugs and Bus-Configured Terminators: Mechanical type, with a lug on the bar for each pole in the panelboard.
4. Feed-Through Lugs: Mechanical type, suitable for use with conductor material. Locate at opposite end of bus from incoming lugs or main device.
5. Subfeed (Double) Lugs: Mechanical type suitable for use with conductor material. Locate at same end of bus as incoming lugs or main device.

G. Future Devices: Panelboards shall have mounting brackets, bus connections, filler plates, and necessary appurtenances required for future installation of devices.

H. Panelboard Short-Circuit Current Rating: Fully rated to interrupt symmetrical short-circuit current available at terminals. Assembly listed by an NRTL for 100 percent interrupting capacity.
2.2 POWER PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Square D, a division of Schneider Electric
   2. G.E., a division of ABB
   4. Eaton Corporation, Cutler-Hammer Products

B. Panelboards: NEMA PB 1, distribution type.

C. Doors: Secured with vault-type latch with tumbler lock; keyed alike.
   1. For doors more than 36 inches (914 mm) high, provide two latches, keyed alike.


E. Branch Overcurrent Protective Devices for Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Square D, a division of Schneider Electric
   2. G.E., a division of ABB
   4. Eaton Corporation, Cutler-Hammer Products

B. Panelboards: NEMA PB 1, lighting and appliance branch-circuit type.

C. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

D. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 DISCONNECTING AND OVERCURRENT PROTECTIVE DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Square D, a division of Schneider Electric
   2. G.E., a division of ABB
   4. Eaton Corporation, Cutler-Hammer Products

B. MCCB: Comply with UL 489, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers:
a. Inverse time-current element for low-level overloads.
b. Instantaneous magnetic trip element for short circuits.
c. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.


3. Electronic Trip Circuit Breakers:
   a. RMS sensing.
   b. Field-replaceable rating plug or electronic trip.
   c. Digital display of settings, trip targets, and indicated metering displays.
   d. Multi-button keypad to access programmable functions and monitored data.
   e. Ten-event, trip-history log. Each trip event shall be recorded with type, phase, and magnitude of fault that caused the trip.
   f. Integral test jack for connection to portable test set or laptop computer.
   g. Field-Adjustable Settings:

      1) Instantaneous trip.
      2) Long- and short-time pickup levels.
      3) Long and short time adjustments.
      4) Ground-fault pickup level, time delay, and I squared T response.

4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller; let-through ratings less than NEMA FU 1, RK-5.

5. GFCI Circuit Breakers: Single- and double-pole configurations with Class A ground-fault protection (6-mA trip).

6. GFEP Circuit Breakers: Class B ground-fault protection (30-mA trip).


9. MCCB Features and Accessories:
   a. Standard frame sizes, trip ratings, and number of poles.
   b. Breaker handle indicates tripped status.
   c. UL listed for reverse connection without restrictive line or load ratings.
   d. Lugs: Mechanical style, suitable for number, size, trip ratings, and conductor materials.
   e. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and HID lighting circuits.
   f. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

2.5 IDENTIFICATION

A. Panelboard Label: Manufacturer's name and trademark, voltage, amperage, number of phases, and number of poles shall be located on the interior of the panelboard door.

B. Breaker Labels: Faceplate shall list current rating, UL and IEC certification standards, and AIC rating.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install panelboards and accessories according to NECA 407.

C. Mount panels at height above finished floor so that no operating handle of switch or circuit breaker in the on position is higher than 79 inches (2000 mm).

D. Mount panelboard cabinet plumb and rigid without distortion of box.

E. Mount recessed panelboards with fronts uniformly flush with wall finish and mating with back box.

F. Install overcurrent protective devices and controllers not already factory installed.

1. Set field-adjustable, circuit-breaker trip ranges.

G. Make grounding connections and bond neutral for services and separately derived systems to ground. Make connections to grounding electrodes, separate grounds for isolated ground bars, and connections to separate ground bars.

H. Install filler plates in unused spaces.

I. Stub four 1-inch (27-EMT) empty conduits from panelboard into accessible ceiling space if so constructed or space designated to be ceiling space in the future. Stub four 1-inch (27-EMT) empty conduits into raised floor space or below slab not on grade.

J. Arrange conductors in gutters into groups and bundle and wrap with wire ties.

3.2 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; install warning signs complying with requirements in "Identification for Electrical Systems."

B. Create a directory to indicate installed circuit loads; incorporate Owner's final room designations. Obtain approval before installing. Handwritten directories are not acceptable. Install directory inside panelboard door.

C. Panelboard Nameplates: Label each panelboard with a nameplate complying with requirements for identification specified in "Identification for Electrical Systems."

D. Device Nameplates: Label each branch circuit device in power panelboards with a nameplate complying with requirements for identification specified in "Identification for Electrical Systems."

E. Install warning signs complying with requirements in "Identification for Electrical Systems" identifying source of remote circuit.

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Acceptance Testing Preparation:
   1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
   2. Test continuity of each circuit.

C. Tests and Inspections:
   1. Perform each visual and mechanical inspection and electrical test for low-voltage air circuit breakers stated in NETA ATS. 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.

D. Panelboards will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports, including a certified report that identifies panelboards included and that describes scanning results, with comparisons of the two scans. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

END OF SECTION
SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Standard-grade receptacles, 125 V, 20 A.
   2. USB receptacles.
   3. GFCI receptacles, 125 V, 20 A.
   4. Toggle switches.
   5. Wall-box dimmers.
   6. Wall plates.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

B. Wiring Devices:
   2. Eagle Electric Manufacturing Co.
   3. Hubbell Incorporated; Wiring Device-Kellems.
   4. Leviton Mfg Company
   5. Pass & Seymour/Legrand; Wiring Devices Div.
2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and use.

B. Comply with NFPA 70.

C. RoHS compliant.

D. Comply with NEMA WD 1.

E. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.
2. SPD Devices: Blue.

F. Wall Plate Color: For plastic covers, match device color.

G. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.3 STANDARD-GRADE RECEPTACLES, 125 V, 20 A

A. Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Standards: Comply with UL 498 and FS W-C-596.

B. Weather-Resistant Duplex Receptacle, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-20R.
4. Marking: Listed and labeled as complying with NFPA 70, "Receptacles in Damp or Wet Locations" Article.

2.4 GFCI RECEPTACLES, 125 V, 20 A

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.
2. Configuration: NEMA WD 6, Configuration 5-20R.
3. Type: [Feed] [Non-feed] through.
4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper- and Weather-Resistant, GFCI Duplex Receptacles, 125 V, 20 A:
1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Square face.
2. Configuration: NEMA WD 6, Configuration 5-15R.
3. Type: [Feed] [Non-feed] through.
4. Standards: Comply with UL 498 and UL 943 Class A.
5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" and "Receptacles in Damp or Wet Locations" articles.

2.5 TOGGLE SWITCHES, 120/277 V, 20 A

A. Two-Pole Switches, 120/277 V, 20 A: Comply with UL 20 and FS W-S-896.
D. Lighted Single-Pole Switches, 120/277 V, 20 A:
   1. Description: Handle illuminated when switch is [on] [off].
   2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.6 WALL PLATES

A. Single Source: Obtain wall plates from same manufacturer of wiring devices.
B. Single and combination types shall match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: 0.035-inch- (1-mm-) thick, satin-finished, Type 302 stainless steel.
   3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.
C. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant die-cast aluminum with lockable cover.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.
B. Coordination with Other Trades:
   1. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
2. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
3. Install wiring devices after all wall preparation, including painting, is complete.

C. Device Installation:
   1. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
   2. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

D. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

E. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.2 FIELD QUALITY CONTROL

A. Tests for Receptacles:
   1. Line Voltage: Acceptable range is 105 to 132 V.
   2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
   3. Ground Impedance: Values of up to 2 ohms are acceptable.
   4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
   5. Using the test plug, verify that the device and its outlet box are securely mounted.

B. Wiring device will be considered defective if it does not pass tests and inspections.

END OF SECTION
SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Fusible switches.
2. Nonfusible switches.
3. Receptacle switches.
4. Shunt trip switches.
5. Molded-case circuit breakers (MCCBs).
7. Enclosures.

1.2 DEFINITIONS

A. NC: Normally closed.
B. NO: Normally open.
C. SPDT: Single pole, double throw.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include nameplate ratings, dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).
4. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.
5. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and SKM electronic format.

B. Shop Drawings: For enclosed switches and circuit breakers.

1. Include plans, elevations, sections, details, and attachments to other work.
2. Include wiring diagrams for power, signal, and control wiring.
1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.

1. Include the following:
   
a. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
   b. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device. Provide in PDF and SKM format electronic format.

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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than one of each size and type.

2. Fuse Pullers: One for each size and type.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Accredited by NETA.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

1.8 FIELD 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 (minus 30 deg C) and not exceeding 104 deg F (40 deg C).


1.9 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year(s) from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single manufacturer.

B. Product Selection forRestricted 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.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and application.

D. Comply with NFPA 70.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Square D, a division of Schneider Electric
2. G.E., a division of ABB
4. Eaton Corporation, Cutler-Hammer Products

2.3 FUSIBLE SWITCHES

A. Type HD, Heavy Duty:

1. Single throw.
2. Three pole.
3. 600-V ac.
4. 200 A and smaller.
5. UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate indicated fuses.
6. Lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

B. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
5. Hookstick Handle: Allows use of a hookstick to operate the handle.
6. Lugs: Mechanical type, suitable for number, size, and conductor material.
7. Service-Rated Switches: Labeled for use as service equipment.
2.4 NONFUSIBLE SWITCHES

A. Type GD, General Duty, Three Pole, Single Throw, 240-V ac, 600 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

B. Type HD, Heavy Duty, Three Pole, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.
   3. Isolated Ground Kit: Internally mounted; insulated, labeled for copper and aluminum neutral conductors.
   4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
   5. Hookstick Handle: Allows use of a hookstick to operate the handle.
   6. Lugs: Mechanical type, suitable for number, size, and conductor material.
   7. Service-Rated Switches: Labeled for use as service equipment.

2.5 MOLDED-CASE CIRCUIT BREAKERS

A. Circuit breakers shall be constructed using glass-reinforced insulating material. Current carrying components shall be completely isolated from the handle and the accessory mounting area.

B. Circuit breakers shall have a toggle operating mechanism with common tripping of all poles, which provides quick-make, quick-break contact action. The circuit-breaker handle shall be over center, be trip free, and reside in a tripped position between on and off to provide local trip indication. Circuit-breaker escutcheon shall be clearly marked on and off in addition to providing international I/O markings. Equip circuit breaker with a push-to-trip button, located on the face of the circuit breaker to mechanically operate the circuit-breaker tripping mechanism for maintenance and testing purposes.

C. The maximum ampere rating and UL, IEC, or other certification standards with applicable voltage systems and corresponding interrupting ratings shall be clearly marked on face of circuit breaker. Circuit breakers shall be 100 percent rated.

D. MCCBs shall be equipped with a device for locking in the isolated position.

E. Lugs shall be suitable for \(194 \text{ deg F (90 deg C)}\) rated wire, sized according to the \(167 \text{ deg F (75 deg C)}\) temperature rating in NFPA 70.

F. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.


I. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.
2. Long- and short-time pickup levels.
3. Long- and short-time time adjustments.
4. Ground-fault pickup level, time delay, and I-squared t response.

J. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

K. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

L. Ground-Fault Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

M. Ground-Fault Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

N. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.
4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.
5. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.
6. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.
7. Zone-Selective Interlocking: Integral with electronic trip unit; for interlocking ground-fault protection function.

2.6 MOLDED-CASE SWITCHES

A. Description: MCCB with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

B. Standard: Comply with UL 489 with interrupting capacity to comply with available fault currents.

C. Features and Accessories:

1. Standard frame sizes and number of poles.
2. Lugs:
   a. Mechanical type, suitable for number, size, trip ratings, and conductor material.
   b. Lugs shall be suitable for 194 deg F (90 deg C) rated wire, sized according to the 167 deg F (75 deg C) temperature rating in NFPA 70.
3. Ground-Fault Protection: Comply with UL 1053; remote-mounted and powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

4. Shunt Trip: Trip coil energized from separate circuit, with coil-clearing contact.

2.7 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: UL 489, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

B. Enclosure Finish: The enclosure shall be finished with gray baked enamel paint, electrodeposited on cleaned, phosphatized steel (NEMA 250 Type 1), gray baked enamel paint, electrodeposited on cleaned, phosphatized galvannealed steel (NEMA 250 Types 3R, 12).

C. Conduit Entry: NEMA 250 Types 4, 4X, and 12 enclosures shall contain no knockouts. NEMA 250 Types 7 and 9 enclosures shall be provided with threaded conduit openings in both endwalls.

D. Operating Mechanism: The circuit-breaker operating handle shall be externally operable with the operating mechanism being an integral part of the box, not the cover, directly operable through the front cover of the enclosure (NEMA 250 Type 1), directly operable through the dead front trim of the enclosure (NEMA 250 Type 3R). The cover interlock mechanism shall have an externally operated override. The override shall not permanently disable the interlock mechanism, which shall return to the locked position once the override is released. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

E. Enclosures designated as NEMA 250 Type 4, 4X stainless steel, 12, or 12K shall have a dual cover interlock mechanism to prevent unintentional opening of the enclosure cover when the circuit breaker is ON and to prevent turning the circuit breaker ON when the enclosure cover is open.

F. NEMA 250 Type 7/9 enclosures shall be furnished with a breather and drain kit to allow their use in outdoor and wet location applications.

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 of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Commencement of work shall indicate Installer's acceptance of the areas and conditions as satisfactory.

3.2 PREPARATION

1. Notify Owner no fewer than 14 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 Owner's written permission.
4. Comply with NFPA 70E.

3.3 ENCLOSURE ENVIRONMENTAL RATING APPLICATIONS

A. Enclosed Switches and Circuit Breakers: Provide enclosures at installed locations with the following environmental ratings.
   1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
   2. Outdoor Locations: NEMA 250, Type 3R.
   3. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

3.4 INSTALLATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.
B. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.
C. Temporary Lifting Provisions: Remove temporary lifting of eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.
D. Install fuses in fusible devices.
E. Comply with NFPA 70 and NECA 1.

3.5 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."
   1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.
   2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.
B. Tests and Inspections for Switches:
   1. Visual and Mechanical Inspection:
      a. Inspect physical and mechanical condition.
      b. Inspect anchorage, alignment, grounding, and clearances.
      c. Verify that the unit is clean.
      d. Verify blade alignment, blade penetration, travel stops, and mechanical operation.
      e. Verify that fuse sizes and types match the Specifications and Drawings.
      f. Verify that each fuse has adequate mechanical support and contact integrity.
g. Inspect bolted electrical connections for high resistance using one of the two following methods:

1) Use a low-resistance ohmmeter.
   a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
   a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

h. Verify that operation and sequencing of interlocking systems is as described in the Specifications and shown on the Drawings.

i. Verify correct phase barrier installation.

j. Verify lubrication of moving current-carrying parts and moving and sliding surfaces.

2. Electrical Tests:

a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

b. Measure contact resistance across each switchblade fuseholder. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.

c. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with switch closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.

d. Measure fuse resistance. Investigate fuse-resistance values that deviate from each other by more than 15 percent.

e. Perform ground fault test according to NETA ATS 7.14 "Ground Fault Protection Systems, Low-Voltage."

C. Tests and Inspections for Molded Case Circuit Breakers:

1. Visual and Mechanical Inspection:

a. Verify that equipment nameplate data are as described in the Specifications and shown on the Drawings.

b. Inspect physical and mechanical condition.

c. Inspect anchorage, alignment, grounding, and clearances.

d. Verify that the unit is clean.

e. Operate the circuit breaker to ensure smooth operation.

f. Inspect bolted electrical connections for high resistance using one of the two following methods:
1) Use a low-resistance ohmmeter.
   a) Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from those of similar bolted connections by more than 50 percent of the lowest value.

2) Verify tightness of accessible bolted electrical connections by calibrated torque-wrench method in accordance with manufacturer's published data or NETA ATS Table 100.12.
   a) Bolt-torque levels shall be in accordance with manufacturer's published data. In the absence of manufacturer's published data, use NETA ATS Table 100.12.

g. Inspect operating mechanism, contacts, and chutes in unsealed units.

2. Electrical Tests:
   a. Perform resistance measurements through bolted connections with a low-resistance ohmmeter. Compare bolted connection resistance values to values of similar connections. Investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   b. Perform insulation-resistance tests for one minute on each pole, phase-to-phase and phase-to-ground with circuit breaker closed, and across each open pole. Apply voltage in accordance with manufacturer's published data. In the absence of manufacturer's published data, use Table 100.1 from the NETA ATS. Investigate values of insulation resistance less than those published in Table 100.1 or as recommended in manufacturer's published data.
   c. Perform a contact/pole resistance test. Drop values shall not exceed the high level of the manufacturer's published data. If manufacturer's published data are not available, investigate values that deviate from adjacent poles or similar switches by more than 50 percent of the lowest value.
   d. Perform insulation resistance tests on all control wiring with respect to ground. Applied potential shall be 500-V dc for 300-V rated cable and 1000-V dc for 600-V rated cable. Test duration shall be one minute. For units with solid state components, follow manufacturer's recommendation. Insulation resistance values shall be no less than two megohms.
   e. Determine the following by primary current injection:
      1) Long-time pickup and delay. Pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
      2) Short-time pickup and delay. Short-time pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
      3) Ground-fault pickup and time delay. Ground-fault pickup values shall be as specified. Trip characteristics shall not exceed manufacturer's published time-current characteristic tolerance band, including adjustment factors.
      4) Instantaneous pickup. Instantaneous pickup values shall be as specified and within manufacturer's published tolerances.
   f. Test functionality of the trip unit by means of primary current injection. Pickup values and trip characteristics shall be as specified and within manufacturer's published tolerances.
g. Perform minimum pickup voltage tests on shunt trip and close coils in accordance with manufacturer's published data. Minimum pickup voltage of the shunt trip and close coils shall be as indicated by manufacturer.

h. Verify correct operation of auxiliary features such as trip and pickup indicators; zone interlocking; electrical close and trip operation; trip-free, anti-pump function; and trip unit battery condition. Reset all trip logs and indicators. Investigate units that do not function as designed.

i. Verify operation of charging mechanism. Investigate units that do not function as designed.

3. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

4. 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 enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.
   b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.
   c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

5. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

D. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

E. Prepare test and inspection reports.
   1. Test procedures used.
   2. Include identification of each enclosed switch and circuit breaker tested and describe test results.
   3. List deficiencies detected, remedial action taken, and observations after remedial action.

3.7 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges.

END OF SECTION
SECTION 264313
SURGE PROTECTION FOR LOW-VOLTAGE ELECTRICAL POWER CIRCUITS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:
   1. Type 1 surge protective devices.
   2. Type 2 surge protective devices.
   3. Enclosures.
   4. Conductors and cables.

B. Related Requirements:
   1. Section 262413 "Switchboards" for integral SPDs installed by switchboard manufacturer.
   2. Section 262416 "Panelboards" for integral SPDs installed by panelboard manufacturer.
   3. Section 262726 "Wiring Devices" for integral SPDs installed by receptacle manufacturer.

1.2 DEFINITIONS

A. Inominal: Nominal discharge current.
B. MCOV: Maximum continuous operating voltage.
C. Mode(s), also Modes of Protection: air of electrical connections where the VPR applies.
D. MOV: Metal-oxide varistor; an electronic component with a significant non-ohmic current-voltage characteristic.
E. NRTL: Nationally recognized testing laboratory.
F. OCPD: Overcurrent protective device.
G. SCCR: Short-circuit current rating.
H. SPD: Surge protective device.
I. Type 2 SPDs: Permanently connected SPDs intended for installation on the load side of the service disconnect overcurrent device, including SPDs located at the branch panel.
J. VPR: Voltage protection rating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include electrical characteristics, specialties, and accessories for SPDs.
2. NRTL certification of compliance with UL 1449.
   a. Tested values for VPRs.
   b. Innominal ratings.
   c. MCOV, type designations.
   d. OCPD requirements.
   e. Manufacturer's model number.
   f. System voltage.
   g. Modes of protection.

1.4 INFORMATIONAL SUBMITTALS
A. Field quality-control reports.
B. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS
A. Maintenance Data: For SPDs to include in maintenance manuals.

1.6 WARRANTY
A. Manufacturer's Warranty: Manufacturer agrees to repair or replace SPDs that fail in materials or workmanship within five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TYPE 2 SURGE PROTECTIVE DEVICES (SPDs)
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. APT, a division of Schneider Electric
   2. SSI, an ILSCO Company
   4. Eaton Corporation, Cutler-Hammer Products
   5. G.E., a division of ABB
B. Source Limitations: Obtain devices from single source from single manufacturer.
C. Standards:
   1. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 1449, Type 2.
   2. Comply with UL 1283.
D. Product Options:
   1. Include LED indicator lights for power and protection status.
2. Include internal thermal protection that disconnects the SPD before damaging internal suppressor components.
3. Include NEMA ICS 5, dry Form C contacts rated at 2 A and 24 V ac for remote monitoring of protection status.
4. Include surge counter.

E. Performance Criteria:
1. MCOV: Not less than 125 percent of nominal system voltage for 208Y/120 V and 120/240 V power systems, and not less than 115 percent of nominal system voltage for 480Y/277 V power systems.
2. Peak Surge Current Rating: Minimum single-pulse surge current withstand rating per phase must not be less than 150 kA. Peak surge current rating must be arithmetic sum of the ratings of individual MOVs in a given mode.
3. Protection modes and UL 1449 VPR for grounded wye circuits with 480Y/277 V and 208Y/120 V, three-phase, four-wire circuits must not exceed the following:
   a. Line to Neutral: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
   b. Line to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
   c. Neutral to Ground: 1200 V for 480Y/277 V and 700 V for 208Y/120 V.
   d. Line to Line: 2000 V for 480Y/277 V and 1200 V for 208Y/120 V.

2.2 ENCLOSURES
A. Indoor Enclosures: NEMA 250, Type 1.
B. Outdoor Enclosures: NEMA 250, [Type 3R] [Type 4X].

PART 3 - EXECUTION

3.1 INSTALLATION
A. Comply with NECA 1.
B. Provide OCPD and disconnect for installation of SPD in accordance with UL 1449 and manufacturer’s written instructions.
C. Install leads between disconnects and SPDs short, straight, twisted, and in accordance with manufacturer’s written instructions. Comply with wiring methods in Section 260519 “Low-Voltage Electrical Power Conductors and Cables.”
   1. Do not splice and extend SPD leads unless specifically permitted by manufacturer.
   2. Do not exceed manufacturer’s recommended lead length.
   3. Do not bond neutral and ground.
D. Use crimped connectors and splices only. Wire nuts are unacceptable.

3.2 FIELD QUALITY CONTROL
A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
1. Compare equipment nameplate data for compliance with Drawings and the Specifications.
2. Inspect anchorage, alignment, grounding, and clearances.
3. Verify that electrical wiring installation complies with manufacturer's written installation requirements.

B. SPDs that do not pass tests and inspections will be considered defective.

C. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Complete startup checks in accordance with manufacturer's written instructions.

B. Do not perform insulation-resistance tests of the distribution wiring equipment with SPDs installed. Disconnect SPDs before conducting insulation-resistance tests; reconnect them immediately after the testing is over.

C. Energize SPDs after power system has been energized, stabilized, and tested.

3.4 DEMONSTRATION

A. Train Owner's maintenance personnel to operate and maintain SPDs.

END OF SECTION
SECTION 265119
LED INTERIOR LIGHTING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes the following types of LED luminaires:
   1. Downlight.
   2. Highbay, nonlinear.
   3. Lowbay.
   4. Recessed, linear.
   5. Surface mount, nonlinear.

B. Related Requirements:
   1. Section 260923 "Lighting Control Devices" for automatic control of lighting, including time
      switches, photoelectric relays, occupancy sensors, and multipole lighting relays and
      contactors.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION 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.

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.

1.4 INFORMATIONAL SUBMITTALS

A. 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. Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.
   2. Globes and Guards: One for every 20 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Each luminaire type shall be binned within a three-step MacAdam Ellipse to ensure color consistency among luminaires.

B. Mockups: For interior 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.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect finishes of exposed surfaces by applying a strippable, temporary protective covering before shipping.
1.9 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) from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Ambient Temperature: 41 to 104 deg F (5 to 40 deg C) Delete "Relative Humidity" Subparagraph below for outdoor units.
   1. Relative Humidity: Zero to 95 percent.

B. Altitude: Sea level to 1000 feet (300 m).

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. Factory- Applied Labels: Comply with UL 1598. Include recommended lamps. 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.

C. Recessed luminaires shall comply with NEMA LE 4.

2.3 DOWNLIGHT

A. Nominal Operating Voltage: 277 V ac.

B. Lamp:
   1. Minimum allowable efficacy of 80 lm/W.
   2. CRI as indicated; CCT as indicated
   3. Rated lamp life of 50,000 hours to L70.
   4. Dimmable from 100 percent to 0 percent of maximum light output.
   5. Internal driver.

C. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear finish.
4. Integral junction box with conduit fittings.

D. 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.

E. Standards:
1. ENERGY STAR certified.
2. RoHS compliant.
3. Recessed luminaires shall comply with NEMA LE 4.

2.4 HIGHBAY, NONLINEAR

A. Nominal Operating Voltage: 277 V ac.

B. Lamp:
1. Minimum allowable efficacy of 80 lm/W.
2. CRI as indicated; CCT as indicated
3. Rated lamp life of 50,000 hours to L70.
4. Dimmable from 100 percent to 0 percent of maximum light output.
5. Internal driver.
6. Lens Thickness: At least 0.125-inch (3.175-mm) minimum unless otherwise indicated.

C. Housings:
1. Extruded-aluminum housing and heat sink.
2. Clear finish.
4. Integral junction box with conduit fittings.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Standards:
1. ENERGY STAR certified.
2. RoHS compliant.
3. UL Listing: Listed for damp location.

2.5 LOWBAY

A. Nominal Operating Voltage: 277 V ac.

B. Lamp:
1. Minimum allowable efficacy of 80 lm/W.
2. CRI as indicated; CCT as indicated
3. Rated lamp life of 50,000 hours to L70.
4. Dimmable from 100 percent to 0 percent of maximum light output.
5. Internal driver.
6. Lens Thickness: At least 0.125-inch (3.175-mm) minimum unless otherwise indicated.

C. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear finish.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Standards:
   1. ENERGY STAR certified.
   2. RoHS compliant.
   3. UL Listing: Listed for damp location.

2.6 RECESSED, LINEAR

A. Nominal Operating Voltage: 277 V ac.

B. Lamp:
   1. Minimum allowable efficacy of 85 lm/W.
   2. CRI as indicated; CCT as indicated
   3. Rated lamp life of [35,000] [50,000] <Insert number> hours to L70.
   4. Dimmable from 100 percent to 0 percent of maximum light output.
   5. Internal driver.
   6. Lens Thickness: At least 0.125-inch (3.175-mm) minimum unless otherwise indicated.

C. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear finish.
   3. With integral mounting provisions.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Standards:
   1. ENERGY STAR certified.
   2. RoHS compliant.
   3. UL Listing: Listed for damp location.
   4. NEMA LE 4.
2.7 SURFACE MOUNT, NONLINEAR

A. Nominal Operating Voltage: 277 V ac.

B. Lamp:
   1. Minimum allowable efficacy of 75 lm/W.
   2. CRI as indicated; CCT as indicated
   3. Rated lamp life of 50,000 hours to L70.
   4. Dimmable from 100 percent to 0 percent of maximum light output.
   5. Internal driver.
   6. Lens Thickness: At least 0.125-inch (3.175-mm) minimum unless otherwise indicated.

C. Housings:
   1. Extruded-aluminum housing and heat sink.
   2. Clear finish.
   3. With integral mounting provisions.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Components are designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Standards:
   1. ENERGY STAR certified.
   2. RoHS compliant.
   3. UL Listing: Listed for damp location.

2.8 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. Steel:
   1. ASTM A36/A36M for carbon structural steel.
   2. ASTM A568/A568M for sheet steel.

C. Stainless Steel:
   1. Manufacturer's standard grade.
   2. Manufacturer's standard type, ASTM A240/240M.

D. Galvanized Steel: ASTM A653/A653M.

E. Aluminum: ASTM B209.
2.9 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.

2.10 LUMINAIRE SUPPORT
A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A641/A641M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) 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 luminaire installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION
A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. 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 a vertical force of 400 percent of luminaire weight.

D. Flush-Mounted Luminaires:
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.

E. Wall-Mounted Luminaires:
1. Attached to structural members in walls
2. Do not attach luminaires directly to gypsum board.

F. Suspended Luminaires:
1. Ceiling Mount:
   a. Two 5/32-inch- (4-mm-) diameter aircraft cable supports 10 feet (3 m) in length.
   b. Hook mount.
2. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

G. Ceiling-Grid-Mounted Luminaires:
1. Secure to any required outlet box.
2. Use approved devices and support components to connect luminaire to ceiling grid and building structure in a minimum of four locations, spaced near corners of luminaire.

H. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 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.

3.5 STARTUP SERVICE

A. Comply with requirements for startup specified in Section 260943.23 "Relay-Based Lighting Controls."
SECTION 284621.11
ADDRESSABLE FIRE-ALARM SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Fire-alarm control unit.
   3. System smoke detectors.
   6. Digital alarm communicator transmitter.

B. Related Requirements:
   1. Section "Control Voltage Electric Power Cables" for cables and conductors for fire-alarm systems.

1.2 DEFINITIONS

A. EMT: Electrical Metallic Tubing.
B. FACP: Fire Alarm Control Panel.
C. HLI: High Level Interface.
E. PC: Personal computer.
F. VESDA: Very Early Smoke-Detection Apparatus.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including furnished options and accessories.
   1. Include construction details, material descriptions, dimensions, profiles, and finishes.
   2. Include rated capacities, operating characteristics, and electrical characteristics.

B. Shop Drawings: For fire-alarm system.
   1. Comply with recommendations and requirements in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   2. Include plans, elevations, sections, details, and attachments to other work.
   3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and locations. Indicate conductor
sizes, indicate termination locations and requirements, and distinguish between factory and field wiring.

4. Detail assembly and support requirements.
5. Include voltage drop calculations for notification-appliance circuits.
6. Include battery-size calculations.
7. Include input/output matrix.
8. Include statement from manufacturer that all equipment and components have been tested as a system and meet all requirements in this Specification and in NFPA 72.
9. Include performance parameters and installation details for each detector.
10. Verify that each duct detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
11. Provide program report showing that air-sampling detector pipe layout balances pneumatically within the airflow range of the air-sampling detector.
12. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale; coordinate location of duct smoke detectors and access to them.
   a. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators.
   b. Show field wiring required for HVAC unit shutdown on alarm.
   c. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' control system.
   d. Show field wiring and equipment required for HVAC unit shutdown on alarm and override by firefighters' smoke-evacuation system.
   e. Locate detectors according to manufacturer's written recommendations.
13. Include voice/alarm signaling-service equipment rack or console layout, grounding schematic, amplifier power calculation, and single-line connection diagram.
14. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits and point-to-point wiring diagrams.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level III Level IV technician.
C. NFPA Certification: Obtain certification according to NFPA 72 by a UL-listed alarm company.

1.5 PROJECT CONDITIONS

A. Use of Devices during Construction: Protect devices during construction unless devices are placed in service to protect the facility during construction.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Noncoded, UL-certified addressable system, with multiplexed signal transmission and horn/strobe evacuation.
B. Automatic sensitivity control of certain smoke detectors.

C. All components provided shall be listed for use with the selected system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices:
   2. Heat detectors.
   3. Smoke detectors.
   4. Duct smoke detectors.
   5. Carbon monoxide detectors.
   6. Automatic sprinkler system water flow.

B. Fire-alarm signal shall initiate the following actions:
   1. Continuously operate alarm notification appliances.
   2. Identify alarm and specific initiating device at fire-alarm control unit.
   3. Transmit an alarm signal to the remote alarm receiving station.
   4. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
   5. Close smoke dampers in air ducts of designated air-conditioning duct systems.
   6. Record events in the system memory.
   7. Indicate device in alarm on the graphic annunciator.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:
   1. Valve supervisory switch.
   2. User disabling of zones or individual devices.

D. System trouble signal initiation shall be by one or more of the following devices and actions:
   1. Open circuits, shorts, and grounds in designated circuits.
   2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
   3. Loss of communication with any addressable sensor, input module, relay, control module, remote annunciator, printer interface, or Ethernet module.
   4. Loss of primary power at fire-alarm control unit.
   5. Ground or a single break in internal circuits of fire-alarm control unit.
   6. Abnormal ac voltage at fire-alarm control unit.
   7. Break in standby battery circuitry.
   8. Failure of battery charging.
   9. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Supervisory Signal Actions:
   1. Initiate notification appliances.
   2. Identify specific device initiating the event at fire-alarm control unit.
   3. After a time delay of 200 seconds, transmit a trouble or supervisory signal to the remote alarm receiving station.
   4. Display system status on graphic annunciator.
2.3 PERFORMANCE REQUIREMENTS

2.4 FIRE-ALARM CONTROL UNIT

A. Manufacturers: Subject to compliance with requirements, undefined:

1. Fire-Lite Alarms, Inc.; a Honeywell International company.
2. GE UTC Fire & Security; A United Technologies Company.
5. SimplexGrinnell LP.

B. General Requirements for Fire-Alarm Control Unit:

1. Field-programmable, microprocessor-based, modular, power-limited design with electronic modules, complying with UL 864.
   a. System software and programs shall be held in nonvolatile flash, electrically erasable, programmable, read-only memory, retaining the information through failure of primary and secondary power supplies.
   b. Include a real-time clock for time annotation of events on the event recorder and printer.
   c. Provide communication between the FACP and remote circuit interface panels, annunciators, and displays.
   d. The FACP shall be listed for connection to a central-station signaling system service.
   e. Provide nonvolatile memory for system database, logic, and operating system and event history. The system shall require no manual input to initialize in the event of a complete power down condition. The FACP shall provide a minimum 500-event history log.

2. Addressable Initiation Device Circuits: The FACP shall indicate which communication zones have been silenced and shall provide selective silencing of alarm notification appliance by building communication zone.

3. Addressable Control Circuits for Operation of Notification Appliances and Mechanical Equipment: The FACP shall be listed for releasing service.

C. Alphanumeric Display and System Controls: Arranged for interface between human operator at fire-alarm control unit 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, two line(s) of 40 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.

D. Initiating-Device, Notification-Appliance, and Signaling-Line Circuits:

1. Pathway Class Designations: NFPA 72, Class B.
2. Pathway Survivability: Level 0.
3. Install no more than 50 addressable devices on each signaling-line circuit.
4. Serial Interfaces:
   a. One dedicated RS 485 port for remote station operation using point ID DACT.
   b. One RS 485 port for remote annunciators, Ethernet module, or multi-interface module (printer port).
c. One USB port for PC configuration.
d. One RS 232 port for VESDA HLI connection.
e. One RS 232 port for voice evacuation interface.

E. Smoke-Alarm Verification:
1. Initiate audible and visible indication of an "alarm-verification" signal at fire-alarm control unit.
2. Activate an approved "alarm-verification" sequence at fire-alarm control unit and detector.
3. Record events by the system printer.
4. Sound general alarm if the alarm is verified.
5. Cancel fire-alarm control unit indication and system reset if the alarm is not verified.

F. Notification-Appliance Circuit:
1. Audible appliances shall sound in a three-pulse temporal pattern, as defined in NFPA 72.
2. Where notification appliances provide signals to sleeping areas, the alarm signal shall be a 520-Hz square wave with an intensity 15 dB above the average ambient sound level or 5 dB above the maximum sound level, or at least 75 dBA, whichever is greater, measured at the pillow.
3. Visual alarm appliances shall flash in synchronization where multiple appliances are in the same field of view, as defined in NFPA 72.

G. Transmission to Remote Alarm Receiving Station: Automatically transmit alarm, supervisory, and trouble signals to a remote alarm station.

H. Primary Power: 24-V dc obtained from 120-V ac service and a power-supply module. Initiating devices, notification appliances, signaling lines, trouble signals, supervisory signals shall be powered by 24-V dc source.
1. Alarm current draw of entire fire-alarm system shall not exceed 80 percent of the power-supply module rating.

I. Secondary Power: 24-V dc supply system with batteries, automatic battery charger, and automatic transfer switch.

J. 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.

2.5 MANUAL FIRE-ALARM BOXES

A. Manufacturers: Subject to compliance with requirements, undefined:
1. Fire-Lite Alarms, Inc.; a Honeywell International company.
2. GE UTC Fire & Security; A United Technologies Company.
5. SimplexGrinnell LP.
6. Wheelock; a brand of Eaton.
B. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Single-action mechanism, breaking-glass or plastic-rod type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Double-action mechanism requiring two actions to initiate an alarm, breaking-glass or plastic-rod type; with addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
3. Station Reset: Key- or wrench-operated switch.
4. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
5. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.

2.6 SYSTEM SMOKE DETECTORS

A. Manufacturers: Subject to compliance with requirements, undefined:

1. Fire-Lite Alarms, Inc.; a Honeywell International company.
2. GE UTC Fire & Security; A United Technologies Company.
5. SimplexGrinnell LP.

B. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to 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.
7. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
   a. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F per minute.
   b. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F.
   c. Multiple levels of detection sensitivity for each sensor.
   d. Sensitivity levels based on time of day.

C. Photoelectric Smoke Detectors:
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).

D. Duct Smoke Detectors: Photoelectric type complying with UL 268A.
1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:
   a. Primary status.
   b. Device type.
   c. Present average value.
   d. Present sensitivity selected.
   e. Sensor range (normal, dirty, etc.).
3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.

2.7 HEAT DETECTORS
A. Manufacturers: Subject to compliance with requirements, undefined:
   1. Fire-Lite Alarms, Inc.; a Honeywell International company.
   2. GE UTC Fire & Security; A United Technologies Company.
   5. SimplexGrinnell LP.
B. General Requirements for Heat Detectors: Comply with UL 521.
   1. Temperature sensors shall test for and communicate the sensitivity range of the device.
C. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F or a rate of rise that exceeds 15 deg F per minute unless otherwise indicated.
   1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
   2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
2.8 NOTIFICATION APPLIANCES

A. Manufacturers: Subject to compliance with requirements, undefined:
   1. GE UTC Fire & Security; A United Technologies Company.
   2. SimplexGrinnell LP.
   3. Wheelock; a brand of Eaton.

B. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.

C. General Requirements for Notification Appliances: Connected to notification-appliance signal circuits, zoned as indicated, equipped for mounting as indicated, and with screw terminals for system connections.
   1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.

D. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level of 90 dBA, measured 10 feet from the horn, using the coded signal prescribed in UL 464 test protocol.

E. Visible Notification Appliances: Xenon strobe lights complying with 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:
      a. 75 110 cd.
      b. 75/110 cd, selectable in the field.
   2. Mounting: Wall mounted unless otherwise indicated.
   3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
   4. Flashing shall be in a temporal pattern, synchronized with other units.
   5. Strobe Leads: Factory connected to screw terminals.

2.9 DIGITAL ALARM COMMUNICATOR TRANSMITTER

A. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.

B. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically capture one telephone line(s) and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on either line is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of telephone line to the remote alarm receiving station over the remaining line. Transmitter shall automatically report telephone service restoration to the central station. If service is lost on both telephone lines, transmitter shall initiate the local trouble signal.
C. Local functions and display at the digital alarm communicator transmitter shall include the following:
   1. Verification that both telephone lines are available.
   2. Programming device.
   3. LED display.
   5. Communications failure with the central station or fire-alarm control unit.

D. Digital data transmission shall include the following:
   1. Address of the alarm-initiating device.
   2. Address of the supervisory signal.
   3. Address of the trouble-initiating device.
   4. Loss of ac supply.
   5. Loss of power.
   6. Low battery.
   7. Abnormal test signal.

E. Secondary Power: Integral rechargeable battery and automatic charger.

F. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
   1. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.

B. Examine roughing-in for electrical connections to verify actual locations of connections before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 EQUIPMENT INSTALLATION

A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems."
   1. Devices placed in service before all other trades have completed cleanup shall be replaced.
   2. Devices installed but not yet placed in service shall be protected from construction dust, debris, dirt, moisture, and damage according to manufacturer's written storage instructions.
B. Install wall-mounted equipment, with tops of cabinets not more than 78 inches above the finished floor.

C. Manual Fire-Alarm Boxes:
   1. Install manual fire-alarm box in the normal path of egress within 60 inches of the exit doorway.
   3. The operable part of manual fire-alarm box shall be between 42 inches and 48 inches above floor level. All devices shall be mounted at the same height unless otherwise indicated.

D. Smoke- or Heat-Detector Spacing:
   1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
   2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
   3. Smooth ceiling spacing shall not exceed 30 feet.
   4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A in NFPA 72.
   5. HVAC: Locate detectors not closer than 36 inches from air-supply diffuser or return-air opening.
   6. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.

E. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.

F. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches long shall be supported at both ends.
   1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.

G. Single-Station Smoke Detectors: Where more than one smoke alarm is installed within a dwelling or suite, they shall be connected so that the operation of any smoke alarm causes the alarm in all smoke alarms to sound.

H. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

I. Audible Alarm-Indicating Devices: Install not less than 6 inches below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.

J. Visible Alarm-Indicating Devices: Install adjacent to each alarm bell or alarm horn and at least 6 inches below the ceiling. Install all devices at the same height unless otherwise indicated.

K. Device Location-Indicating Lights: Locate in public space near the device they monitor.
3.3 PATHWAYS
A. Pathways above recessed ceilings and in nonaccessible locations may be routed exposed.
   1. Exposed pathways located less than 96 inches above the floor shall be installed in EMT.
B. Pathways shall be installed in EMT.
C. Exposed EMT shall be painted red enamel.

3.4 CONNECTIONS
A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.
   1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
   2. Smoke dampers in air ducts of designated HVAC duct systems.
   3. Electronically locked doors and access gates.
   4. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
   5. Supervisory connections at valve supervisory switches.
   6. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.
   7. Data communication circuits for connection to building management system.
   8. Data communication circuits for connection to mass notification system.
   9. Supervisory connections at fire-extinguisher locations.
   10. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
   11. Supervisory connections at fire-pump engine control panel.

3.5 IDENTIFICATION
A. Install framed instructions in a location visible from fire-alarm control unit.

3.6 GROUNDING
A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.
B. Ground shielded cables at the control panel location only. Insulate shield at device location.

3.7 FIELD QUALITY CONTROL
A. Field tests shall be witnessed by authorities having jurisdiction.
B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Visual Inspection: Conduct visual inspection prior to testing.
   a. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
   b. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.


3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.

4. Test audible appliances for the private operating mode according to manufacturer's written instructions.

5. Test visible appliances for the public operating mode according to manufacturer's written instructions.

6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

D. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

E. Fire-alarm system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

H. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.8 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fire-alarm system.

END OF SECTION