PROJECT MANUAL

VILLAGE OF WINDSOR

WINDSOR NEW DEPARTMENT OF PUBLIC WORKS BUILDING

DeForest, Wisconsin

September 23, 2019

DIMENSION
Madison Design Group
architecture - interior design - planning
PROJECT: WINDSOR NEW DEPARTMENT OF PUBLIC WORKS BUILDING
4160 COUNTY HIGHWAY V
DE FOREST, WISCONSIN

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DIMENSION IV MADISON PROJECT NO.: 18029
DATE OF PROJECT MANUAL: September 23, 2019

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The following documents contain information about existing conditions, which are pertinent to the Work of this Project and are available for the general information of all Bidders. The availability of such information shall not relieve any Bidder from responsibility to visit the Project Site, to become familiar with the local conditions under which the Work is to be performed and to correlate the Bidder’s observations with the requirements of the Bidding Documents.

1. GEOTECHNICAL EXPLORATION REPORT

   A. The Geotechnical Report, as prepared by Edge Consulting Engineers, Inc., dated May 9, 2019, is for Contractor’s reference. The Architect/Engineer does not certify its completeness or accuracy. The Contractor may do additional testing and evaluation to verify subsurface conditions at Contractor’s expense. A copy of the report is bound herein following as part of this Section 00 2000.

END OF SECTION 00 2000
PREPARED FOR:

GED PROJECT NUMBER: 19700

GEOTECHNICAL REPORT

WINDSOR NEW DEPARTMENT OF PUBLIC WORKS BUILDING

EDGE PROJECT NUMBER: 19700

May 9, 2019
GEOTECHNICAL REPORT

Project Name & Address: Windsor New Department of Public Works Building 4160 County Road V Windsor, Wisconsin 53532

Property Information: W ¼ of Section 09, T9N, R10E Village of Windsor Dane County, Wisconsin

Client: Dimension IV – Madison Design Group 6515 Grand Teton Plaza, Suite 120 Madison, WI 53719 Contact: Jim Gersich Phone: 608.829.4453

Owner: Village of Windsor 4084 Mueller Road DeForest, WI 53532 Contact: Tina Butteris Phone: 608.888.0066

Consultant: Edge Consulting Engineers, Inc. 624 Water Street Prairie du Sac, Wisconsin 53578 Contact: Brian Beaulieu, P.E. Phone: 608.644.1449

Edge Project Number: 19700

Date: May 9, 2019

Kaitlin Rinabarger Geotechnical Specialist

Arlen Ostreng, P.E. Geotechnical Manager
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SECTION 1
INTRODUCTION

1.1 PROJECT INFORMATION

This report summarizes the results of a geotechnical exploration conducted by Edge Consulting Engineers, Inc. (Edge Consulting) for the Village of Windsor, who is considering constructing a new public works building at 4160 County Road V in the Village of Windsor, Dane County, Wisconsin. The subject property is located in an existing rural area. The property contains cropped agricultural fields and a farmstead including a barn, two sheds, and a two story residence.

The site is located east of Highway 51 on Parcel #: 196/0910-093-8515-0 and is further located in the West ½ of Section 10, Township 9 North, Range 10 East, Village of Windsor, Dane County, Wisconsin. The location of the project site on the Morrisonville, Wisconsin United States Geological Survey (USGS) Quadrangle is shown in Figure 1. Inspection of the site survey and quadrangle indicates that the site elevation is approximately 975 feet above mean sea level. The location of the site on a street map is illustrated in Figure 2. A site plan describing the project is included in Figure 3.

1.2 PURPOSE OF REPORT

The investigative activities of this report were conducted for the purposes of providing geotechnical engineering design parameters, soil characteristics, building foundation recommendations, and site development recommendations with respect to the proposed improvements. This assessment was completed in conformance with Client directed protocols, and utilizing the judgment of the geotechnical engineer.

1.3 PROJECT DESCRIPTION

The proposed project includes the construction of a new single-story (30,000 sq.ft. footprint) public works building with semi-conditioned and unconditioned storage spaces, offices and mezzanine over the office space. The building is proposed to be framed using structural steel with exterior finishes consisting of metal siding and brick accents. There is no basement currently included with the project. The foundation for the building is assumed to be a concrete frost wall with footing.

1.4 SCOPE OF SERVICES

The scope of services for this project included research of reference materials and field exploration. Section 5 contains a list of references consulted in the preparation of this report. The scope of services for this report was determined predominantly by client supplied standards.

Field exploration was proposed to consist of advancing five borings in the vicinity of the proposed building to a depth of 30 feet bgs, or until auger refusal. Edge Consulting reviewed the boring logs, the recovered soil samples, and laboratory testing results (if
any) to determine the engineering characteristics of the soils at or near the proposed building location. This report summarizes the field exploration results and provides recommendations related to suitable foundation types and depths, allowable bearing pressure, and estimates of foundation settlement.

The scope of services for this report does not include any environmental assessment or investigation for the presence of hazardous or toxic materials in the soil, groundwater, or surface water within or beyond the subject site. Any statements in this report or on the test boring log regarding odors, staining of soils, or other unusual conditions observed, are strictly for the information of the client.
SECTION 2
EXPLORATION RESULTS

2.1 REFERENCE RESEARCH & BACKGROUND

Review of United States Department of Agriculture NRCS (Natural Resource Conservation Service) Web Soil Survey for Dane County indicates natural site soils are classified as “PnB” (Plano silt loam, till substratum) and “RnC2” (Ringwood silt loam). These soil types are typically well drained soils that are gradually sloping to moderately steeply sloping and consist of loess over loamy till. The soils are typically classified as CL-ML and SC-SM on the Unified Soil Classification System. The risk of corrosion to uncoated steel is low to moderate and for concrete is low. Edge Consulting reviewed the “Thickness of Unconsolidated Material in Wisconsin” map prepared by the Geologic and Natural History Survey. This map indicates that the anticipated depth to bedrock is between 50-100 feet, with underlying bedrock consisting of dolomite with some sandstone and shale of the Prairie du Chien Group.

2.2 TOPOGRAPHY

The existing topography of the subject site is gradually sloping, with surface water generally flowing to the south. Existing slopes are approximately 2-12%. Site drainage is adequate, and no standing water was observed during drilling operations.

2.3 FIELD EXPLORATION

Soil Essentials, Ltd. performed the field drilling services for the project. Six (6) standard penetration test (SPT) soil borings were completed at the site to depths between 9 and 30 feet below ground surface (bgs) at predetermined locations within the vicinity of the proposed building. Drilling was completed on April 26, 2019. The borings were advanced using a rotary drill rig. Representative soil samples were obtained using a standard 2-inch diameter split spoon sampler in general accordance with ASTM D 1586-08, “Standard Method for Penetration Tests and Split-Barrel Sampling of Soils”. A description of this procedure is available in Appendix C of this report. Split spoon sampling was performed by collecting 18 inch samples at 2.5-foot intervals to a depth of 15 feet and 5 foot intervals thereafter.

The drill crew chief visually and manually classified samples in the field in accordance with ASTM D 2487-06. The field personnel then collected representative soil samples from each split spoon and placed these samples in glass jars for further examination and verification of the field classification by a geotechnical engineer. The soil boring logs located in Appendix A contain pocket penetrometer readings, standard penetration measurements, soil classification information and other pertinent information.

Upon completion of drilling, the soil borings were abandoned in accordance with Chapter NR 141, Wisconsin Administrative Code.
2.4 SUBSURFACE CONDITIONS

Six (6) soil borings were completed at the site. The borings were completed as close to the predetermined boring locations as practical. The approximate locations of the borings are depicted in Figure 3.

Subsurface soils at the proposed building’s southeast corner (SB-1) consisted of approximately 2 inches of topsoil followed by fine to medium sand and gravel to 1 foot bgs. Medium to stiff silty clay was then encountered to 6 feet bgs followed by medium dense to dense fine to medium silty sand with some gravel and occasional cobbles. Very dense fine to medium silty sand with some gravel and occasional cobbles was then observed to the end of the boring and maximum depth explored at 30 feet bgs.

Subsurface soils at the proposed building’s southwest corner (SB-2) consisted of approximately 4 inches of topsoil followed by medium dense silty sand and gravel with cobbles to 3 feet bgs. Medium silty clay was then encountered to 6 feet bgs followed by medium dense fine to medium silty sand and sand with gravel and some cobbles to 23 feet bgs followed by very dense fine to medium silty sand and sand with gravel and some cobbles to the end of the boring and maximum depth explored at 30 feet bgs.

Subsurface soils at the proposed building’s center (SB-3) consisted of approximately 10 inches of topsoil followed by medium to stiff silty clay with some sand and gravel to 6 feet bgs. Very soft silty clay with some sand and gravel was then encountered to 8.5 feet bgs followed by very dense fine to medium sand and gravel with occasional cobbles to the end of the boring and auger refusal at 13 feet bgs.

Subsurface soils at the proposed building’s northwest corner (SB-4) consisted of approximately 1.3 feet of topsoil followed by stiff silty clay to 3 feet bgs followed by loose to medium dense fine sand with some gravel and occasional cobbles and boulders to 8 feet bgs. Very dense silty fine sand with some gravel and occasional cobbles and boulders was then observed to the end of the boring and auger refusal at 9 feet bgs.

Subsurface soils at the proposed building’s northeast corner (SB-5) consisted of approximately 1.4 feet of topsoil followed by medium to stiff silty clay to 7 feet bgs. Medium dense fine to medium silty sand and sand with gravel and some cobbles was then encountered to 23 feet bgs followed by very dense fine to medium silty sand and sand with gravel and some cobbles to the end of the boring and maximum depth explored at 30 feet bgs.

A sixth (confirmation) boring was advanced approximately 38 feet south of boring SB-4. The boring was blind drilled to 13.5 feet bgs. Subsurface soils consisted of 1.2 feet of topsoil followed by silty clay to 5.5 feet bgs. Dense fine medium sand with some silt, gravel and occasional cobbles was then encountered to 23 feet bgs followed by very dense fine medium sand with some silt, gravel and occasional cobbles to the end of the boring and maximum depth explored at 25 feet bgs.

Detailed information concerning the soils encountered is included in the boring logs in Appendix A.
2.5 BEDROCK

Auger refusal was encountered within the proposed building’s building center boring (SB-3) at 13 feet bgs and the northwest corner boring (SB-4) at 9 feet bgs. A confirmation boring was advanced approximately 38 feet south of boring SB-4, and the boring was drillable to the maximum depth explored at 25 feet bgs. The remaining borings were drilled to the maximum depth explored at 30 feet bgs. It is believed that the auger refusal was the result of encountering large cobbles or boulders and not competent bedrock.

2.6 FROST DEPTH AND COVER

Frost depth for the area is expected to be 4 feet. It is recommended that all foundation elements, not bearing directly on solid rock or otherwise protected from frost, be provided with a minimum cover depth of 4 feet to adequately protect against frost in accordance with Section 1809.5 of the International Building Code (IBC).

2.7 WATER LEVEL OBSERVATIONS

Groundwater was encountered during drilling operations within the southeast corner boring (SB-1) at 18 feet bgs (951 feet amsl) and the southwest corner boring (SB-2) at 18 feet bgs (950 feet amsl). Groundwater was not observed in the other borings. Seasonal fluctuations in groundwater elevation should be expected. For design purposes, it is recommended that the groundwater table be assumed to be at 16 feet bgs (approximately 953 feet amsl).

2.8 LABORATORY TESTING

No laboratory testing was conducted as part of this investigation.
SECTION 3
ANALYSIS & RECOMMENDATIONS

3.1 SITE PREPARATION & FILL RECOMMENDATIONS

The following general site preparation and fill recommendations are provided for the development of this site.

- All vegetation, root-mat, topsoil, and any other soft or unsuitable material should be stripped from the proposed building and drive areas. Site strippings should be placed outside of the future construction areas. These materials should not be utilized for backfill purposes.
- Removal of unsuitable fill material should be conducted within the footprint of the proposed buildings and pavement areas. Any construction debris should be removed from the site. The remaining material may be used as fill in other “non load bearing” areas of the site outside of the building and pavement footprints.
- All building and pavement areas of the site requiring fill should be brought up to grade with Select fill. Select fill material should consist of clean well graded granular material containing less than 15% by weight passing the No. 200 sieve. This material should be placed in thin lifts not exceeding 10 inches in a loose thickness and compacted to a minimum of 95% of the maximum dry density, as determined by ASTM D 1557, Modified Proctor test.
- Excavate building foundations to prescribed depths. Any unsuitable materials identified in the foundation trenches should be undercut and brought up to grade with engineered fill. Fill areas under footings should be extended from each side of the outermost location of the footing at a rate of 1 foot width for every 1 foot of fill depth. Fill placement activities should be performed in the presence of a qualified geotechnical engineer.
- Once final grade for footing placement has been established, density tests and/or inspection by a geotechnical engineer should be performed in the footing excavations prior to footing placement to confirm they are suitable for footing placement.
- Foundation construction should follow in accordance with the structural engineer’s requirements.
- Once the prescribed curing time of foundation elements has been achieved, installation of any required perimeter drainage system and backfill may be initiated. Backfill of foundation walls may consist of onsite or imported granular material. Backfill should be installed in a maximum of 10 inch lifts and compacted to a 90% of the maximum dry density.

3.2 FOUNDATIONS

Based on the site grading plan, the proposed public works building finished floor elevation is anticipated to be ~975.75’. Assuming this elevation, northern end of the building will be in a cut condition (up to 4.5’ deep), while the south end of the building will be in a fill condition (up to 7’ deep). Perimeter footings for the building are anticipated to bear at ~971.75’ (4’ below finished floor).
Given the proposed footing elevation and information obtained during this investigation, we recommend that the proposed building be supported on conventional strip footings founded on natural existing medium to stiff silty clay, medium dense to dense silty sand or engineered fill. The following table illustrates the assumed bearing elevation of footings for the building along with the recommended bearing capacity of the soils at these locations.

**Table 3.2 Bearing Capacity**

<table>
<thead>
<tr>
<th>Building Area</th>
<th>Footing Base Elevation</th>
<th>Bearing Capacity (psf)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Building Perimeter Walls &amp; Interior Column Footings (South End – SB-1 &amp; SB-2)</td>
<td>Above Existing Grade *see below</td>
<td>2,000 (Engineered Fill)</td>
</tr>
<tr>
<td>Building Perimeter Walls &amp; Interior Column Footings (Middle &amp; NE Corner – SB-3, SB-5)</td>
<td>1’-6’ BGS *see below</td>
<td>2,000 (Medium to Stiff Silty Clay)</td>
</tr>
<tr>
<td>Building Perimeter Walls &amp; Interior Column Footings (NW Corner – SB-4, SB-6)</td>
<td>7’-9’ BGS</td>
<td>3,500 (Med Dense to Dense Silty Sand)</td>
</tr>
</tbody>
</table>

* Based upon the anticipated footing elevations, most of the proposed building foundations are expected to bear on existing medium to stiff silty clay soils or fill sections of the site.

All existing organic topsoil should be stripped/removed from the building footprint. Toothed and smooth edge backhoe buckets should be used to excavate to the footing grade within the structure limits. The footing subgrade excavation should be observed by a qualified geotechnical engineer prior to pouring footings to check for unsuitable soils that would require removal. If unsuitable soils are encountered they should be removed and replaced with engineered fill. For this project, 3-inch dense graded base aggregate is recommended as the engineered fill replacement of unsuitable material below the footing bases. Smaller gradation base aggregate (3/4-inch or 1 1/4”-inch) may also be used to top off the larger 3-inch material or fractured limestone for forming of footings.

Undercut excavations required below the prescribed footing base elevation should be widened a foot per foot of depth for stress distribution purposes. The fill should be placed in maximum of 10-inch lifts and compacted until deflection ceases. In all cases, the exposed subgrade or new fill should be compacted to within 95% of the Modified Proctor (ASTM D 1557) maximum dry density.

Foundations for the proposed building may be proportioned for a net allowable soil bearing pressure as listed in the Table 3.2. The net allowable soil bearing pressure refers to that pressure in excess of the final minimum overburden pressure placed on the soil.
Perimeter foundations/frost walls for the buildings should bear a minimum depth of 4 feet below final exterior grades for frost protection. Interior footings can be supported at higher elevations, provided they are founded on materials as described above.

We further recommend that the minimum width of individual column footings be 30 inches and the minimum recommended width of continuous wall footings be 18 inches. These minimum recommended widths are given to prevent disproportionately small footing sizes.

Based on the above recommendations, we anticipate the total potential settlement of the building to be less than 1 inch. Differential settlement is expected to be limited to less than half of this amount.

### 3.3 SEISMIC DESIGN

The soils encountered at this site from 1 – 6 feet bgs generally had SPT blow counts (N-Values) between 5 and 13 blows/foot. The soils encountered from 6 to 20 feet bgs generally had SPT blow counts between 15 and 45 blows/foot. The soils encountered from 20 to 30 feet bgs generally had SPT blow counts between 50 to over 100 blows/foot. It is our opinion that the average soil properties for the in the upper 100 feet can be generally characterized as stiff soils. Based upon this characterization the site can be considered as Site Class D for seismic design in accordance with Table 1615.1.1 of the International Building Code.

### 3.4 INTERIOR FLOOR SLABS

The building interior concrete floor slabs are recommended to be supported by an aggregate base course section of at least 6-inches. The base course shall consist of 1 ¼-inch or ¾-inch material to limit the effects of moisture and provide uniform support. A vapor barrier below the slab should also be considered to further limit the effects of moisture as well as to aid in proper concrete curing. All floor slabs should be structurally separated from the foundations and be provided with construction joints and fiber or wire mesh reinforcement for cracking control in accordance with ACI 302.1R80, Chapter 2.3.

Concrete floor slabs should be designed (thickness and reinforcement) in accordance with current American Concrete Institute (ACI) 302.1R80 practice. We recommend a minimum thickness of at least 4-inches for non-traffic bearing surfaces. A subgrade modulus of 80 psi/in is recommended for design purposes. For traffic bearing interior concrete floor slabs within the storage portion of the building, we recommend a minimum thickness of at least 6-inches. Prior to slab construction, the subgrades should be proof-rolled /re-compacted to densify loose or disturbed soils. The provided design subgrade modulus is based on a re-compacted subgrade assuming non-yielding subgrade conditions are developed. Areas that do not proof-roll satisfactorily should be under cut further and replaced with additional breaker stone and/or geotextile fabric.

Concrete mixes for interior use should be designed for durability with minimum of compressive strength of 4,000 psi using ¾-inch aggregate. Air entrained mixes with 6.0% minimum air content are also recommended to be specified in accordance with ACI 318.
3.5 EXTERIOR CONCRETE SLABS

Exterior concrete slabs for non-traffic bearing sidewalks are recommended to be a minimum of 5-inches thick while trash enclosure and other small load bearing slabs should be a minimum of 7-inches thick. All slabs should be supported on aggregate base course of at least 10-inches. A subgrade modulus of 80 psi/in. is recommended for exterior concrete pavement design founded on proof-rolled soils.

Concrete mixes for exterior use should be designed for durability with minimum of compressive strength of 4,000 psi using ¾-inch aggregate. Air entrained mixes with 6.0% minimum air content should also be specified in accordance with ACI 318 to minimize frost damage.

Exterior concrete should be sloped at least 2% (1/4 inch per foot), where permissible, to provide adequate surface drainage. Concrete shall also be properly cured, protected and jointed. All work should follow ACI 330R-08 “Guide for the Design and Construction of Concrete Parking Lots”.

Concrete Deicing salt should be avoided during the initial few years after construction to minimize spalling effects. It is further recommended that exterior concretes exposed to salts be protected with a siloxane based water and chloride repellent after they are properly cured.

3.6 AGGREGATE AND PAVEMENT RECOMMENDATIONS

The successfulness of subgrade development will dictate the requirements for aggregate installation. In general it is recommended that the pavement design provide for a 10” minimum aggregate base thickness consisting of 6-inches of 3-inch dense graded base aggregate and 4-inches of 1 ¼-inch dense graded base aggregate. Subgrade soils should be proof-rolled prior to aggregate installation. If stable soils are not achievable at the required base elevation additional subgrade stabilization measures including further undercutting and/or installation of a subgrade reinforcement geotextile fabric such as the Mirafi HP series may be required.

All aggregate materials shall be installed in lifts of no more than 6-inches and be compacted between lifts with a smooth drum or rubber tired roller.

It is understood the desired asphalt pavement design for parking lot and access drive pavements (Traffic Class III) assumes the pavements will be subject to average daily truck traffic (ADTT) with less than 29 Equivalent Single Axle Loads (ESLs). Accordingly, the pavement sections tabulated below were selected assuming a high plasticity silty clay subgrade with SSV value of approximately 4.0 and a design life of 20 years.
3.7 EXCAVATION SLOPE RECOMMENDATIONS

It is expected that short term slopes of 1:1 can be maintained in the soils encountered at this site. However, construction practices should follow all federal, state and local regulations regarding safety standards for all excavation activities.

Construction site safety is the sole responsibility of the Contractor. Edge Consulting assumes no liability for Contractor’s construction activities, construction site safety, or interpretation of information provided within this report. Such responsibility shall neither be implied nor inferred.

3.8 SPECIAL DESIGN CONSIDERATIONS

Soft material was encountered between 6’ to 8’ BGS within the boring at the building center (SB-3). Removal of unsuitable material may be necessary if encountered during construction activities.

3.9 SPECIAL CONSTRUCTION CONSIDERATIONS

If earthwork is to be performed during the winter months, any soils which are frozen or contain frost must not be used as fill material. Any in-place subgrade or fill soils which have become frozen or contain frost should be removed before placing additional fill. These materials may be stockpiled for future use after they have thawed.
The quality of foundations and floor slab subgrades will likely be determined by the level of care exercised during site development. To check that earthwork and foundation construction proceeds in accordance with these recommendations, the following operations should be monitored by a qualified geotechnical engineer:

- Fill/backfill placement and compaction
- Proof-rolling and Subgrade Stabilization with the construction areas
- Foundation excavation
- Concrete placement
SECTION 4
LIMITATIONS AND RESTRICTIONS

This report has been prepared to aid in the evaluation of this property for the intended use described herein, and to assist in the design or planning of this project. In the event any changes in the design as outlined herein, or changes in the vertical position or horizontal location of the facility are planned, the conclusions and recommendations contained in this report shall not be considered valid unless such changes are reviewed by Edge Consulting Engineers, Inc.

The analysis and recommendations submitted in this report are our opinions based on the data obtained and subsurface conditions noted from the field investigation described at the locations indicated on the accompanying site plan. This report does not reflect any variations that may occur between, beyond, or below the depths of these test pits or borings. If variations then appear evident, it will be necessary for a re-evaluation of the recommendations of this report to be made after performing on-site observations during the construction period and noting the characteristics of any variations.

The soil report is only for the purposes stated in the contract and may not be sufficient to prepare an accurate bid.

Certain assumptions have been made regarding the foundation design for this site. Edge Consulting Engineers, Inc. should be given the opportunity to review the final foundation design to determine whether the final design necessitates any changes of the recommendations contained in this document. If Edge Consulting is not provided the opportunity for this review, we can assume no responsibility for the misinterpretation or misapplication of these recommendations or for their validity in the event changes have been made to the initial understanding of the project or design content.

There is the possibility that variations in soil conditions will be encountered during construction. In order to permit correlation between soil data in this report and the actual soil conditions encountered during construction, it is required that the soil engineer be retained to perform a review of the excavation prior to foundation placement. Edge Consulting assumes no responsibility for construction compliance with design concepts, specifications, or recommendations unless we have been retained to perform on-site review during the course of construction. Edge Consulting should be contacted immediately if conditions encountered are not consistent with those described.

This report was prepared in accordance with generally accepted soil and foundation engineering practices and makes no other warranties, either expressed or implied, as to the professional advice provided under the terms of the agreement between the Engineer and his client. This report has not been prepared for uses or parties other than those specifically named, or for uses or applications other than those enumerated herein. The report may contain insufficient or inaccurate information for other purposes, applications, building sites, or other uses.
SECTION 5
REFERENCES

Figure 1

Street Maps
FIGURE #1
Regional Map

Project Number: #19700
Project Info: Windsor New Department of Public Works Building
Project Location: 4160 County Road V Windsor, WI 53532
<table>
<thead>
<tr>
<th>Project Number:</th>
<th>#19700</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project Info:</td>
<td>Windsor New Department of Public Works Building</td>
</tr>
<tr>
<td>Project Location:</td>
<td>4160 County Road V Windsor, WI 53532</td>
</tr>
</tbody>
</table>

**FIGURE #2**  
Street Map

**Proposed Site Location**

[Map Image]
Figure 2

USGS Topographic Quadrangle Map
FIGURE #3
7.5 Minute USGS Quadrangle Map

Project Number: #19700
Project Info: Windsor New Department of Public Works Building
Project Location: 4160 County Road V Windsor, WI 53532
Figure 3

Site Plan
FIGURE #4
Aerial Site Plan

Project Number: #19700
Project Info: Windsor New Department of Public Works Building
Project Location: 4160 County Road V Windsor, WI 53532
SOIL BORING LOCATION MAP

NEW DEPARTMENT OF PUBLIC WORKS BUILDING

RELOCATED SALT SHED

FUEL

SB-1
SB-2
SB-3
SB-4
SB-5
SB-6

WINDSOR NEW DEPARTMENT OF PUBLIC WORKS BUILDING
CTY HWY V, WINDSOR, WI

19/700
5/2/2019
EX-1.dgn
5/2/2019
CD
19700
SB-1
SB-2
SB-3
SB-4
SB-5
SB-6

PUBLIC WORKS BUILDING
NEW DEPARTMENT
FUEL
RELOCATED SALT SHED

SOIL BORING LOCATION MAP
Figure 4

Site Photographs
FIGURE #5
Site Photographs

Project Number:  #19700
Project Info:  Windsor New Department of Public Works Building
Project Location:  4160 County Road V Windsor, WI 53532
Photograph Date:  April 5, 2019
FIGURE #5
Site Photographs

Project Number: #19700
Project Info: Windsor New Department of Public Works Building
Project Location: 4160 County Road V Windsor, WI 53532
Photograph Date: April 26, 2019
Appendix A

Soil Boring Logs
**Project:** Windsor New Department of Public Works Building  
**Project Location:** Windsor, Wisconsin  
**Project Number:** 19700

<table>
<thead>
<tr>
<th>Log of Boring SB-1</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Date(s) Drilled:</strong> April 26, 2019</td>
</tr>
<tr>
<td><strong>Logged By:</strong> CRJ</td>
</tr>
<tr>
<td><strong>Checked By:</strong> N/A</td>
</tr>
<tr>
<td><strong>Drilling Method:</strong> Hollow Stem Auger</td>
</tr>
<tr>
<td><strong>Drill Rig Type:</strong> Geoprobe 7822DT</td>
</tr>
<tr>
<td><strong>Groundwater Level and Date Measured:</strong> 18 feet ATD</td>
</tr>
<tr>
<td><strong>Drill Bit Size/Type:</strong> 2 inch Split Spoon</td>
</tr>
<tr>
<td><strong>Drilling Contractor:</strong> Soil Essentials</td>
</tr>
<tr>
<td><strong>Sampling Method(s):</strong> SPT, Grab</td>
</tr>
<tr>
<td><strong>Hammer Data:</strong> 140 lb, 30 in drop, rope &amp; cathead</td>
</tr>
<tr>
<td><strong>Total Depth of Borehole:</strong> 30 feet bgs</td>
</tr>
<tr>
<td><strong>Approximate Surface Elevation:</strong> 969 feet MSL</td>
</tr>
</tbody>
</table>

**Backfill:** Bentonite/Cuttings  
**Location:** Southeast Corner

---

### Material Description

<table>
<thead>
<tr>
<th>Elevation, Depth, Sample Type</th>
<th>Sample Number</th>
<th>Sampling/Resist./Blowcount</th>
<th>Relative Consistency</th>
<th>USCS Symbol</th>
<th>Graphic Log</th>
<th>Moisture</th>
<th>Qu (bls/ft)</th>
<th>Recovery (in)</th>
<th>Remarks and Other Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>2&quot; Topsoil</td>
<td></td>
<td></td>
<td>M</td>
<td>-</td>
<td></td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Dark Brown Fine to Medium Sand and Gravel</td>
<td>7,7,6 Stiff</td>
<td>Brown Silty Clay</td>
<td>M</td>
<td>4.0</td>
<td>1.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>Brown Fine to Medium Silty Sand w/Some Gravel and Occasional Cobbles (Till)</td>
<td>6,11,14 Medium Dense</td>
<td>D - 15</td>
<td>D</td>
<td>-</td>
<td>15</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Very Dense</td>
<td></td>
<td></td>
<td>M</td>
<td>-</td>
<td>6</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Bottom of Boring at 30 feet bgs**

Figure 1
### Log of Boring SB-2

**Project Location:** Windsor, Wisconsin  
**Project Number:** 19700

<table>
<thead>
<tr>
<th>Date(s) Drilled</th>
<th>Logged By</th>
<th>Checked By</th>
<th>Total Depth of Borehole</th>
<th>Approximate Surface Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 26, 2019</td>
<td>CRJ</td>
<td>N/A</td>
<td>30 feet bgs</td>
<td>968 feet MSL</td>
</tr>
</tbody>
</table>

**Drilling Method:** Hollow Stem Auger  
**Drill Rig Type:** Geoprobe 7822DT  
**Groundwater Level and Date Measured:** 18 feet ATD

**Backfill:** Bentonite/Cuttings  
**Location:** Southwest Corner

<table>
<thead>
<tr>
<th>Date</th>
<th>Elevation, feet</th>
<th>Depth, feet</th>
<th>Sample Number</th>
<th>Sample Type</th>
<th>Relative Consistency</th>
<th>USCS Symbol</th>
<th>Sample Resist./blow</th>
<th>Moisture</th>
<th>Qu (ksi)</th>
<th>Recovery (in)</th>
<th>Remarks and Other Tests</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>968</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7,6,5</td>
<td>963</td>
<td>1</td>
<td>Medium Dense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M</td>
<td>-</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td>2,2,3</td>
<td>958</td>
<td>2</td>
<td>Medium</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M</td>
<td>-</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>3,6,8</td>
<td>953</td>
<td>3</td>
<td>Medium Dense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>-</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>11,15,16</td>
<td>948</td>
<td>4</td>
<td>Dense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>D</td>
<td>-</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>8,10,13</td>
<td>943</td>
<td>5</td>
<td>Medium Dense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M</td>
<td>-</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>28,15,12</td>
<td>933</td>
<td>6</td>
<td>Medium Dense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M/W</td>
<td>-</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>22,38,41</td>
<td>938</td>
<td>7</td>
<td>Very Dense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>M/W</td>
<td>-</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>1000''</td>
<td>938</td>
<td>8</td>
<td>Very Dense</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>W</td>
<td>-</td>
<td>7</td>
<td></td>
</tr>
<tr>
<td></td>
<td>933</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Bottom of Boring at 30 feet bgs</td>
</tr>
</tbody>
</table>

(Material Description)

Elevation, feet: 0-968  
Depth, feet: 0-30  
Sample Number: 0-8  
Sample Type: Medium, Dense  
Rel. Consistency: Medium, Dense  
USCS Symbol: M, D, M/W  
Sample Resist./blow: M, M/W  
Moisture: M, D, M/W  
Qu (ksi): -  
Recovery (in): 0-16  
Remarks and Other Tests: M/W  
Bottom of Boring at 30 feet bgs
**Project: Windsor New Department of Public Works Building**
**Project Location: Windsor, Wisconsin**
**Project Number: 19700**

### Log of Boring SB-3

**Sheet 1 of 1**

<table>
<thead>
<tr>
<th>Date(s) Drilled</th>
<th>Logged By</th>
<th>Checked By</th>
<th>Total Depth of Borehole</th>
<th>Approximate Surface Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 26, 2019</td>
<td>CRJ</td>
<td>N/A</td>
<td>13 feet bgs</td>
<td>973 feet MSL</td>
</tr>
</tbody>
</table>

**Drilling Method:** Hollow Stem Auger

**Drill Rig Type:** Geoprobe 7822DT

**Groundwater Level and Date Measured:** Not Encountered ATD

**Backfill:** Bentonite/Cuttings

**Logged By:** CRJ

**Drill Bit Size/Type:** 2 inch Split Spoon

**Drilling Contractor:** Soil Essentials

**Sampling Method(s):** SPT, Grab

**Hammer Data:** 140 lb, 30 in drop, rope & cathead

**Borehole Location:** Building Center

---

### MATERIAL DESCRIPTION

<table>
<thead>
<tr>
<th>Elevation, feet</th>
<th>Depth, feet</th>
<th>Sample Number</th>
<th>Sampling Resistance, blowcount</th>
<th>Relative Consistency</th>
<th>USCS Symbol</th>
<th>Moisture</th>
<th>Qn (bl/ft)</th>
<th>Recovery (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>973</td>
<td>0</td>
<td></td>
<td>CO</td>
<td>Stiff</td>
<td>CL-</td>
<td>M</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>1</td>
<td></td>
<td>101</td>
<td></td>
<td>M</td>
<td>3.5</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td></td>
<td>2</td>
<td></td>
<td>212</td>
<td>Medium</td>
<td>M</td>
<td>-</td>
<td>4</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3</td>
<td></td>
<td>313</td>
<td>Very Soft</td>
<td>M/W</td>
<td>0</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4</td>
<td></td>
<td>414</td>
<td>Very Dense</td>
<td>SP</td>
<td>D</td>
<td>- 10</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5</td>
<td></td>
<td>515</td>
<td>Very Dense</td>
<td>D</td>
<td>-</td>
<td>1</td>
<td></td>
</tr>
</tbody>
</table>

**Remarks and Other Tests:**
- **0 M- -**
- **1 5,7,7 Stiff M3 41 46**
- **2 2,2,3 Medium M- 4**
- **3 woh,woh,woh Very Soft M/W 0 17**
- **4 14,24,28 Very Dense D-1 0**
- **5 60<1"-,- Very Dense D**

- **Bottom of Boring and Auger Refusal at 13 feet bgs**

---

**Graphic Log**

---

![Graphic Log Image](image-url)
### Log of Boring SB-4

**Project:** Windsor New Department of Public Works Building  
**Project Location:** Windsor, Wisconsin  
**Project Number:** 19700

<table>
<thead>
<tr>
<th>Date(s) Drilled</th>
<th>Logged By</th>
<th>Checked By</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 26, 2019</td>
<td>CRJ</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Hollow Stem Auger**  
**Drill Rig Type:** Geoprobe 7822DT  
**Groundwater Level and Date Measured:** Not Encountered ATD

**Drilling Method:** Hollow Stem Auger  
**Drill Rig Type:** Geoprobe 7822DT  
**Groundwater Level and Date Measured:** Not Encountered ATD

**Drill Rig Type:** Geoprobe 7822DT  
**Drilling Contractor:** Soil Essentials  
**Groundwater Level and Date Measured:** Not Encountered ATD

**Backfill:** Bentonite/Cuttings  
**Location:** Northwest Corner

**Hammer Data:** 140 lb, 30 in drop, rope & cathead

**Total Depth of Borehole:** 9 feet bgs  
**Approximate Surface Elevation:** 979 feet MSL

<table>
<thead>
<tr>
<th>Depth, feet</th>
<th>Sample Type</th>
<th>Sample Number</th>
<th>Sampling Method(s)</th>
<th>Relative Consistency</th>
<th>USCS Symbol</th>
<th>MATERIAL DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.3’ Topsoil</td>
</tr>
<tr>
<td>1</td>
<td>Stiff</td>
<td>4,5,6</td>
<td></td>
<td></td>
<td></td>
<td>Brown Silty Clay</td>
</tr>
<tr>
<td>2</td>
<td>Loose</td>
<td>3,4,5</td>
<td></td>
<td></td>
<td></td>
<td>Brown Silty Fine Sand w/Some Gravel and Occasional Cobbles and Boulders (Till)</td>
</tr>
<tr>
<td>3</td>
<td>Medium</td>
<td>6,10,13</td>
<td></td>
<td></td>
<td></td>
<td>Bottom of Boring and Auger Refusal at 9 feet bgs</td>
</tr>
<tr>
<td>4</td>
<td>Very Dense</td>
<td>1004444</td>
<td></td>
<td></td>
<td></td>
<td>Bottom of Boring and Auger Refusal at 9 feet bgs</td>
</tr>
</tbody>
</table>

**Remarks and Other Tests:**

- **Sample Type:**
  - CL-CH: Brown Silty Clay
  - SP-SM: Brown Silty Fine Sand w/Some Gravel and Occasional Cobbles and Boulders (Till)

- **Sample Number:**
  - 4,5,6: Stiff
  - 3,4,5: Loose
  - 6,10,13: Medium
  - 1004444: Very Dense

- **Sampling Method(s):**
  - SPT, Grab

- **Relative Consistency:**
  - D/M: D/D, D/D, D/D
  - D/M: D/D, D/D, D/D

- **USCS Symbol:**
  - CL-CH: Brown Silty Clay
  - SP-SM: Brown Silty Fine Sand w/Some Gravel and Occasional Cobbles and Boulders (Till)

- **Graphic Log:**
  - Moisture (M): -
  - Qu (blows/foot): 2.2
  - Recovery (in): 16
  - D/M: -
  - Recovery (in): 13
  - D/M: -
  - Recovery (in): 15
  - D/M: -
  - Recovery (in): 0

**Figure 4**
**Log of Boring SB-5**

**Project Location:** Windsor, Wisconsin  
**Project Number:** 19700

<table>
<thead>
<tr>
<th>Date Drilled</th>
<th>Logged By</th>
<th>Checked By</th>
<th>Total Depth of Borehole</th>
<th>Approximate Surface Elevation</th>
</tr>
</thead>
<tbody>
<tr>
<td>April 26, 2019</td>
<td>CRJ</td>
<td>N/A</td>
<td>30 feet bgs</td>
<td>976 feet MSL</td>
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</tbody>
</table>

**Drilling Method:** Hollow Stem Auger  
**Drill Rig Type:** Geoprobe 7822DT  
**Drill Rig Contractor:** Soil Essentials  
**Groundwater Level and Date Measured:** Not Encountered ATD  
**Borehole Backfill:** Bentonite/Cuttings  
**Sampling Method(s):** SPT, Grab  
**Hammer Data:** 140 lb, 30 in drop, rope & cathead  
**Sampling Location:** Northeast Corner

---

**Material Description:**

<table>
<thead>
<tr>
<th>Elevation, feet</th>
<th>Depth, feet</th>
<th>Sample Number</th>
<th>Sample Resistance, blowcount</th>
<th>Relative Consistency</th>
<th>USCS Symbol</th>
<th>Moisture</th>
<th>Qu (tsf)</th>
<th>Recovery (in)</th>
<th>Remarks and Other Tests</th>
</tr>
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<tbody>
<tr>
<td>976</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>M</td>
<td>-</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>971</td>
<td>1</td>
<td>1,3,5</td>
<td>Medium</td>
<td>Dark Brown Silty Clay</td>
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<tr>
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<td>1,2,9</td>
<td>Stiff</td>
<td>Brown Silty Fine to Medium Sand w/Some Gravel and Occasional Cobbles (Till)</td>
<td>M</td>
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<td>17</td>
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<td></td>
</tr>
<tr>
<td>956</td>
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<td>9,10,12</td>
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<td></td>
<td>D</td>
<td>-</td>
<td>13</td>
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<td></td>
</tr>
<tr>
<td>951</td>
<td>5</td>
<td>8,13,14</td>
<td>Medium Dense</td>
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<td>D</td>
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<td>14</td>
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</tr>
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<td>946</td>
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<td>10013&quot;-&quot;</td>
<td>Very Dense</td>
<td>Brown Fine to Medium Sand and Gravel w/Cobbles</td>
<td>D</td>
<td>-</td>
<td>13</td>
<td></td>
<td></td>
</tr>
<tr>
<td>941</td>
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<td>Very Dense</td>
<td></td>
<td>D</td>
<td>-</td>
<td>10</td>
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<td></td>
</tr>
<tr>
<td>936</td>
<td>8</td>
<td>10004&quot;-&quot;</td>
<td>Very Dense</td>
<td>Bottom of Boring at 30 feet bgs</td>
<td>D</td>
<td>-</td>
<td>3</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Figure 5**
**Log of Boring SB-6**

**Date(s) Drilled**: April 26, 2019  
**Logged By**: CRJ  
**Checked By**: N/A  

**Drilling Method**: Hollow Stem Auger  
**Drill Rig Type**: Geoprobe 7822DT  
**Groundwater Level and Date Measured**: Not Encountered ATD

**Backfill**: Bentonite/Cuttings  
**Drill Bit Size/Type**: 2 inch Split Spoon  
**Drilling Contractor**: Soil Essentials  
**Sampling Method(s)**: SPT, Grab  
**Hammer Data**: 140 lb, 30 in drop, rope & cathead

**Project**: Windsor New Department of Public Works Building  
**Project Location**: Windsor, Wisconsin  
**Project Number**: 19700  
**Total Depth of Borehole**: 25 feet bgs  
**Approximate Surface Elevation**: 977 feet MSL

**Location**: Northwest Corner - Offset Approximately 38 feet South of SB-4

<table>
<thead>
<tr>
<th>Elevation, feet</th>
<th>Depth, feet</th>
<th>Sample Number</th>
<th>Sampling Resistance, blow/foot</th>
<th>Relative Consistency</th>
<th>USCS Symbol</th>
<th>Graphic Log</th>
<th>MATERIAL DESCRIPTION</th>
<th>Moisture</th>
<th>Qu (bsf)</th>
<th>Recovery (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>977</td>
<td>0</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1.2' Topsoil</td>
<td>M</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Brown Silty Clay</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>972</td>
<td>5</td>
<td>1</td>
<td>9,20,16</td>
<td>Dense</td>
<td>C-L</td>
<td></td>
<td>Brown Fine to Medium Sand w/Some Silt, Gravel and Occasional Cobbles (Till)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>970</td>
<td>10</td>
<td>2</td>
<td>12,20,27</td>
<td>Dense</td>
<td>C-L</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>967</td>
<td>15</td>
<td>3</td>
<td>1003&quot;,-</td>
<td>Very Dense</td>
<td>M-CH</td>
<td></td>
<td>Bottom of Boring at 25 feet bgs</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Remarks and Other Tests**

- OL-OH
- 1.2' Topsoil
- CL-
- CH
- Brown Silty Clay
- SP-SM
- Brown Fine to Medium Sand w/Some Silt, Gravel and Occasional Cobbles (Till)
- D - 15
- D - 16
- D - 3
# Key to Log of Boring

**Project:** Windsor New Department of Public Works Building  
**Project Location:** Windsor, Wisconsin  
**Project Number:** 19700

## COLUMN DESCRIPTIONS

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td><strong>Elevation, feet:</strong> Elevation (MSL, feet)</td>
</tr>
<tr>
<td>2</td>
<td><strong>Depth, feet:</strong> Depth in feet below the ground surface.</td>
</tr>
<tr>
<td>3</td>
<td><strong>Sample Type:</strong> Type of soil sample collected at the depth interval shown.</td>
</tr>
<tr>
<td>4</td>
<td><strong>Sample Number:</strong> Sample identification number.</td>
</tr>
<tr>
<td>5</td>
<td><strong>Sampling Resistance, blows/foot:</strong> Number of blows to advance driven sampler foot beyond seating interval using the hammer identified on the boring log.</td>
</tr>
<tr>
<td>6</td>
<td><strong>Relative Consistency:</strong> Relative consistency of the subsurface material.</td>
</tr>
<tr>
<td>7</td>
<td><strong>USCS Symbol:</strong> USCS symbol of the subsurface material.</td>
</tr>
<tr>
<td>8</td>
<td><strong>Graphic Log:</strong> Graphic depiction of the subsurface material encountered.</td>
</tr>
<tr>
<td>9</td>
<td><strong>MATERIAL DESCRIPTION:</strong> Description of material encountered. May include consistency, moisture, color, and other descriptive text.</td>
</tr>
<tr>
<td>10</td>
<td><strong>Moisture:</strong> Water content of the soil sample, expressed as percentage of dry weight of sample.</td>
</tr>
<tr>
<td>11</td>
<td><strong>Qu (tsf):</strong> Dry weight per unit volume of soil sample measured in laboratory, in pounds per cubic foot.</td>
</tr>
<tr>
<td>12</td>
<td><strong>Recovery (in):</strong> The percent fines (soil passing the No. 200 Sieve) in the sample. WA indicates a Wash Sieve, SA indicates a Sieve Analysis.</td>
</tr>
<tr>
<td>13</td>
<td><strong>REMARKS AND OTHER TESTS:</strong> Comments and observations regarding drilling or sampling made by driller or field personnel.</td>
</tr>
</tbody>
</table>

## FIELD AND LABORATORY TEST ABBREVIATIONS

- **CHEM:** Chemical tests to assess corrosivity  
- **COMP:** Compaction test  
- **CONS:** One-dimensional consolidation test  
- **LL:** Liquid Limit, percent  
- **PI:** Plasticity Index, percent  
- **TYPICAL MATERIAL GRAPHIC SYMBOLS**  
- **TYPICAL SAMPLER GRAPHIC SYMBOLS**  
- **GENERAL NOTES**

1. Soil classifications are based on the Unified Soil Classification System. Descriptions and stratum lines are interpretive, and actual lithologic changes may be gradual. Field descriptions may have been modified to reflect results of lab tests.
2. Descriptions on these logs apply only at the specific boring locations and at the time the borings were advanced. They are not warranted to be representative of subsurface conditions at other locations or times.
Appendix B

Classification of Soils for Engineering Purposes
## Unified Soil Classification System

<table>
<thead>
<tr>
<th>Major divisions</th>
<th>Group symbols</th>
<th>Typical names</th>
<th>Laboratory classification criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gravels</td>
<td>GW</td>
<td>Well-graded gravels, gravel-sand mixtures, little or no fines</td>
<td>( D_{10} ) greater than 4; ( C_u ) between 1 and 3</td>
</tr>
<tr>
<td>Gravels</td>
<td>GP</td>
<td>Poorly graded gravels, gravel-sand mixtures, little or no fines</td>
<td>Not meeting all gradation requirements for GW</td>
</tr>
<tr>
<td>Sand with fines</td>
<td>GM</td>
<td>Silty gravels, gravel-sand-silt mixtures</td>
<td>Above &quot;A&quot; line with P.I. less than 4</td>
</tr>
<tr>
<td>Soil</td>
<td>GC</td>
<td>Clayey gravels, gravel-sand-clay mixtures</td>
<td>Atterberg limits above &quot;A&quot; line with P.I. greater than 7</td>
</tr>
<tr>
<td>Sand</td>
<td>SW</td>
<td>Well-graded sands, gravelly sands, little or no fines</td>
<td>( D_{10} ) greater than 6; ( C_u ) between 1 and 3</td>
</tr>
<tr>
<td>Sand with fines</td>
<td>SP</td>
<td>Poorly graded sands, gravelly sands, little or no fines</td>
<td>Not meeting all gradation requirements for SW</td>
</tr>
<tr>
<td>Clayey clays</td>
<td>SM</td>
<td>Silty sands, sand-silt mixtures</td>
<td>Atterberg limits below &quot;A&quot; line or P.I. less than 4</td>
</tr>
<tr>
<td>Clayey clays</td>
<td>SC</td>
<td>Clayey sands, sand-clay mixtures</td>
<td>Limits plotting in hatched zone with P.I. between 4 and 7 are borderline cases requiring use of dual symbols</td>
</tr>
</tbody>
</table>

For classification of fine-grained soils and fine fraction of coarse-grained soils:

Atterberg Limits plotting in hatched area are borderline classifications requiring use of dual symbols.

Equation of A-line:

\[ P_t = 0.73 (L.L. - 20) \]
The penetration testing procedure used for this project followed the requirements of ASTM Specification D 1586-67, “Standard Method for Penetration Tests and Split-Barrel Sampling of Soils”. This procedure involves driving a 2-inch OD standard split spoon sampler 18 inches with a 140-pound hammer free falling a distance of 30 inches. The number of blows required to drive the sampler the final foot was recorded as the Standard “N” Penetration. This N-value is used by Soils Engineers to estimate the strength and compressibility of the soil. After driving, the sampler was returned to the surface and opened. The length of sample (recovery) was measured and the soil was preliminarily classified according to type by a Soils Technician. A representative portion of each sample was then sealed in a glass jar, labeled, and returned to our office for further examination and testing.
DOCUMENT 00 7000 – GENERAL CONDITIONS


END OF SECTION 00 7000
SECTION 00 8000 – SUPPLEMENTARY CONDITIONS

The following amendments modify, delete and add to AIA 201-2017 General Conditions of the Contract for Construction. Where any article, paragraph or subparagraph in the General Conditions is supplemented by one of the following paragraphs, the provisions of such article, paragraph or subparagraph shall remain in effect and the supplemental provisions shall be considered as added thereto. Where any article, paragraph or subparagraph of the General Conditions is not supplemented, amended, voided or superseded by any of the following paragraphs, the provisions of such Article, paragraph or subparagraph not so amended, voided or superseded shall remain in effect. Amendments are as follows:

1. ARTICLE 1 – GENERAL PROVISIONS

1.1 BASIC DEFINITIONS

1.1.3 THE WORK

At the end of subparagraph 1.1.3, add the following new clause:

“Use of the words “produce” and “provide” where appropriate shall also include “furnish and install”.

1.1.4 THE PROJECT

Add the following sentence:

“A general description of the Project is in Document 01 1000 Summary of the Work.”

1.2 CORRELATION AND INTENT OF THE CONTRACT DOCUMENTS

After 1.2.3, add the following:

“1.2.4 Where a number is listed in the Project Manual (as for gauges, weights, temperatures, amount of time, etc.) the number shall be interpreted as that or better.

1.2.5 Whenever the words “approved”, “satisfactory”, “directed”, “submitted”, “inspected”, or similar words or phrases are used in the product specification sections, it shall be assumed that the words “Architect/Engineer or his representative” follows the verb as the object of the clause, such as “approved by the Architect/Engineer or his representative.””

2. ARTICLE 2 - OWNER

2.1 DEFINITION

After 2.1.2, add the following:

“2.1.3 Refer to Document 00 0001 Title Page for a description of the Owner.”

3. ARTICLE 3 - CONTRACTOR

3.3 SUPERVISION AND CONSTRUCTION PROCEDURES

After 3.3.3, add the following:

“3.3.4 Refer to Section 01 4000 for detailed quality requirements.

3.6 TAXES
After the introductory paragraph, add the following:

“3.6.1 The Owner is a tax exempt entity. Owner shall provide Contractor either proof of its exemption or tax exempt number. Contractor may then issue Wisconsin Sales and Use Tax Exemption Certificates (Form S-211) to its subcontractors and suppliers and purchase construction materials without paying Wisconsin sales tax. Subcontractors may rely upon the Contractor’s tax exemption certificates to issue their own tax exemption certificates to their subcontractors and suppliers, and purchase construction materials without paying Wisconsin sales tax. The Owner is not required to purchase construction materials directly itself from suppliers to save Wisconsin sales tax.

3.6.1.2 Sales tax shall not be included in any bids for construction materials to be incorporated into the project. However, each bidder shall include all applicable sales taxes required by law in the bid for non-materials, e.g. equipment rental, form lumber, consumables like paint brushes, supplies not incorporated into the work, fuel, etc.”

3.7 PERMITS, FEES, NOTICES AND COMPLIANCE WITH LAWS

At 3.7.1 add the following sentence:

3.7.1 Owner will provide Department of Commerce plan review for “Building” and “HVAC” but Contractor shall secure approvals of Component, Plumbing, HVAC, Lighting, Electrical, and Fire Protection Systems for which Contractor shall prepare required forms and pay required fees. Contractor shall provide all other permits that may be required for construction. Contractor shall pay for all concrete testing.

After subparagraph 3.7.5, add the following:

“3.7.6. Where the contract documents require work better than that required by statute, the contract documents shall govern.”

3.12 SHOP DRAWINGS, PRODUCT DATA AND SAMPLES

3.12.6 Add the following sentence:

“Contractor shall use a verification stamp with signature and date to signify his approval of shop drawings.”

After 3.12.5, add the following:

“3.12.5.1 Refer to Section 01 3300 for detailed submittal information.”

3.14 CUTTING AND PATCHING

After 3.14.2, add the following:

“3.14.3 Refer to Section 01 7329 for detailed cutting and patching requirements.”

4. ARTICLE 5 – SUBCONTRACTORS

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

Replace 5.2.4, in its entirety, with the following:

“5.2.4 The Contractor must provide the Owner with a list of all subcontractors, suppliers, and service providers performing, furnishing, or procuring labor, services, materials, plans, or specifications under the contract no later than
seven calendar days after the notice of the intent to award date. The Contractor shall not replace any subcontractor, supplier or service provider without written approval from the Owner."

5. ARTICLE 7 – CHANGES IN THE WORK

7.2 CHANGE ORDERS

After 7.2.1, add the following:

"7.2.2 Refer to Section 01 2400 for detailed change order procedures."

7.4 MINOR CHANGES IN THE WORK

After introductory paragraph, add the following:

"7.4.1 The form used for ordering minor changes not involving time or money shall be AIA Document G710- ARCHITECTS SUPPLEMENTAL INSTRUCTIONS."

After 7.4.1, add the following:

"7.5 CONSTRUCTION BULLETINS

7.5.1 A Construction Bulletin ("CB") is a written document prepared by the Architect/Engineer as a statement of changes in the scope of work which may or may not change the contract amount or time. The Construction Manager shall return the executed CB to the Architect/Engineer on or before the date stated in the CB stating his agreement to change the scope of work and any proposed adjustment to the contract amount and the contract time. All CB items that affect the contract amount or time shall subsequently be recorded on a Change Order."

6. ARTICLE 9 – PAYMENTS AND COMPLETION

9.6 PROGRESS PAYMENTS

Replace all subarticles with the following:

9.6.1 "Based upon applications for payment submitted to the Architect by the Contractor, the Owner shall make progress payments on account of the contract sum to the Contractor as provided below and elsewhere in the contract documents.

9.6.2 The period covered by each application for payment shall be on the 25th day of the month.

9.6.3 Provided an application for payment is received by the Architect not later than the 25th day of a month, the Owner shall make payment to the Contractor not later than the 25th day of the following month. If an application for payment is received by the Architect after the application date fixed above, payment shall be made by the Owner not later than 30 days after the Architect receives the application for payment.

9.6.4 Each application for payment shall be based upon the schedule of values submitted by the Contractor in accordance with the contract documents. The schedule of values shall allocate the entire contract sum among the various portions of the work and be prepared in such form and supported by such data to substantiate its accuracy as the Architect may require. This schedule, unless objected to by the Architect, shall be used as a basis for reviewing the Contractor’s applications for payment.

9.6.5 Application for payment shall indicate the percentage of completion of each portion of the work as of the end of the period covered by the application for payment."
9.6.6 Subject to the provisions of the contract documents, the amount of each progress payment shall be computed as follows:

9.6.6.1 Take that portion of the contract sum properly allocable to completed work as determined by multiplying the percentage completion of each portion of the work by the share of the total contract sum allocated to that portion of the work in the schedule of values, less retainage. Retainage shall be 5% until 50% complete, then retainage decreases to 0%. At such time, Contractor shall arrange for Section 00 6210 Consent of Surety to Reduction in Retainage be prepared by Contractor's Surety, and forwarded directly to AE prior to the next application for payment. Pending final determination of cost to the Owner of changes in the work, amounts not in dispute may be included as provided in Subparagraph 7.3.7 of the General Conditions even though the contract sum has not yet been adjusted by Change Order.

9.6.6.2 Add that portion of the contract sum properly allocable to materials and equipment delivered and suitably stored at the site for subsequent incorporation in the completed construction (or, if approved in advance by the Owner, suitably stored off site at a location agreed upon in writing), less retainage per provisions of 9.6.6.1.

9.6.6.3 Subtract the aggregate of previous payments made by the Owner, and

9.6.6.4 Subtract amounts, if any, for which the Architect has withheld or nullified a certificate of payment as provided in Paragraph 9.6 of the general conditions.

9.6.7 The progress payment amount determined in accordance with Paragraph 5.6 shall be further modified per Paragraph 9.6 of the supplementary conditions:

9.6.7.1 Add, if final completion of the work is thereafter materially delayed through no fault of the Contractor, any additional amounts payable in accordance with Subparagraph 9.10.3 of the general conditions.

9.6.8 Reduction or limitation of retainage, if any, shall be per Paragraph 9.6 of the supplementary conditions.

9.6.9 The Owner reserves the right to make direct payment to subcontractors or to pay the prime contractor with checks that are made payable to the prime contractor and to one or more subcontractors. In the event the County receives notice from any person, subcontractor, supplier or other third party, that the Contractor has failed to pay such person(s) for work performed in accordance with the project, the Contractor shall, at the request of the Owner, and in no more than 10 calendar days, provide all documentation the Owner believes necessary to determine whether such payment is due, or reasons for non-payment of disputed amounts. In the event the Owner determines the claim to be valid and payment is due, or in the absence of aforementioned documentation, the Owner may authorize direct payment of any unpaid bills, withholding from the Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such claims until satisfactory documentation is furnished that all liabilities have been fully discharged or reasons for non-payment of disputed amounts are provided by the Contractor. In no event shall these provisions be construed to impose any obligations upon the Owner to either the Contractor or the Contractor's Surety. In paying any unpaid bills of the Contractor relating to the work, the Owner shall be deemed the agent of the Contractor, and any payment so made by the Owner, shall be considered as a payment made under the Contract by the Owner to the Contractor for its account and the Owner shall not be liable to the Contractor for any such payment made in good faith."

9.8 SUBSTANTIAL COMPLETION

After 9.8.5 add the following:

"9.8.6 Failure to reach final completion within 60 days from total substantial completion of the project shall be cause to terminate the contract and the Contractor's surety shall be notified accordingly."
9.10  FINAL COMPLETION AND FINAL PAYMENT

Add to Subparagraph 9.10.1 the following clauses:

.1 The AE will promptly make the first inspection. If the work is not acceptable and the contract not fully performed, the AE will notify the Contractor, in writing, of all unfinished work and fix the time within which the Contractor shall complete the items listed. Upon notification by the Contractor that the list of uncompleted items is complete, the AE will make a follow-up inspection trip.

.2 Time spent by the AE to follow-up on such unfinished work to determine that the Contractor has fully performed the Contract shall be paid for by the Contractor on the basis of the AE’s regular hourly rate schedule for supplementary services and reimbursable expenses as stated in the AE’s agreement for services with the Owner.

.3 Payment for all such additional services required of the AE will be deducted from the balance due the Contractor, duly noted on the final certificate for payment and paid by the Owner directly to the AE.

After 9.10.5 add the following:

“9.10.6 Refer to Section 01 7700 for detailed contract closeout procedures.”

7.  ARTICLE 11 – INSURANCE AND BONDS

11.1  CONTRACTOR’S INSURANCE AND BONDS

After 11.1.1 add the following:

“11.1.1.1 The insurance required shall be written for not less than the following limits, or greater if required by law:

1.  Worker’s Compensation:
   a)  State Statutory Limit.
   b)  Employer’s Liability: $500,000 per Accident.

2.  Comprehensive or Commercial General Liability (including Premises-Operations; Independent Contractor’s Protective; Products and Completed Operations; Broad Form Property Damage):
   a)  Bodily Injury and Property Damage:
       $1,000,000 Combined Single Limit (CSL) Each Occurrence Minimum $2,000,000 Aggregate or Per Project Endorsement.

3.  Contractual Liability:
   a)  Bodily Injury and Property Damage:
       $1,000,000 Combined Single Limit (CSL) Each Occurrence Minimum $2,000,000 Aggregate or Per Project Endorsement.

4.  Business Auto Liability (including owned, non-owned and hired vehicles):
   a)  Bodily Injury and Property Damage:
       $1,000,000 Combined Single Limit (CSL) Each Occurrence Minimum $2,000,000 Aggregate or Per Project Endorsement.

5.  Umbrella Excess Liability:
   a)  $2,000,000 over primary insurance.
   b)  Maximum self-insured retention of $25,000.

6.  The Owner and AE shall be named as additional insureds.

11.1.1.2 If this insurance is written on the Comprehensive General Liability policy form, the Certificates shall be AIA Document G705, Certificate of Insurance. If this insurance is written on a Commercial General Liability policy form, ACORD form 25 will be acceptable.”
8. ARTICLE 12 – UNCOVERING AND CORRECTION OF WORK

12.2 CORRECTION OF WORK

Throughout subparagraphs 12.2.1 to 12.2.5 change “one year” to “two years”. The Contractor shall provide a two-year period for the correction of work.

END OF SECTION 00 8000
PART 1 - GENERAL

1.1 PROJECT LOCATION

A. The Project Site is located at 4160 County Highway V, De Forest, Wisconsin.

1.2 DESCRIPTION OF THE WORK

A. The Work of this Project consists, in general, of a new Department of Public Works building. The building will be a slab-on-grade pre-engineered metal structure. The building will require loading docks, offices, breakroom, conference room and toilets. The exterior of the building will include cultured stone. Interior spaces will include carpeting, vinyl flooring, ceramic tile, acoustical tile, and metal grate stairs. Work will also include mechanical, electrical, plumbing and fire protection systems. The scope of the Project includes all rough and finish work as shown on plans and described within the specifications.

B. Note that the scope of work includes relocating two (2) structures from the Village Hall site to this new site. The structures to be moved are the Salt Shed and the Fueling Island. Coordinate relocation with Owner.

C. Work shall be complete, including appurtenances, all as shown on the Project Drawings and specified in the Project Manual. Labor, materials, products, equipment, transportation, services and the like shall be provided in quantities to complete the Project. Singular specifications shall be considered plural where they apply.

1.3 TYPE OF CONTRACT

A. The Work embraced by the Contract Documents shall be constructed under a single prime contract.

1.4 WORK BY OTHERS

A. Items indicated “N.I.C.” on the Project Drawings will be furnished and installed by others not a party to the Prime Contract.

1.5 WORKING DAY

A. Work on the Project shall be done between the hours of 7:00 A.M. and 5:00 P.M. If at any time during construction it becomes necessary to accelerate the Work in order to meet completion dates for portions or all of the Work, all trades shall work overtime at no additional cost to the Owner.

1. There may be certain construction activities or installation work that will need to occur after or before normal hours of operation for reasons of safety, disruption of operations, or contractor convenience. Modified work hours to be coordinated in advance with the Owner.

1.6 TIME FOR COMPLETION

A. Date of Commencement of the Work: Date to be established by Owner’s written notice to proceed.

B. Date of Substantial Completion: 300 calendar days from date of commencement.

C. Final Completion: The completion of all Work according to the contract Documents, approved by the AE and accepted by the Owner shall be as stated in the Supplementary Conditions.
D. Exceptions: The only exceptions to the above completion dates are delay or termination because of a national emergency and/or extension of time for completion claimed and allowed according to the General Conditions and/or Supplementary Conditions.

1.7 CLEANING

A. Keep premises free of accumulation of surplus materials and rubbish resulting from operations. Remove all rubbish from premises. No burning of rubbish on premises allowed. Do not throw rubbish from windows or roof. The General Contractor shall be responsible for supplying dumpsters, including required recycling dumpsters for waste like cardboard and shall maintain dumpsters throughout the project for the use of all Contractors, including furniture and equipment contractors, until directed by A/E for their removal.

B. Accomplish rubbish removal weekly and additionally as directed by the AE. Keep interior of building free of unattended combustible rubbish at all times. Each subcontractor shall remove the rubbish generated by his/her own activities to the dumpsters provided.

C. Remove all tools, equipment, scaffolding and temporary facilities immediately when no longer required for execution of the Work.

D. Broom clean all floors as construction progresses as necessary to eliminate dirt and trash accumulation. Coordinate and direct the overall cleanliness of the premises.

E. Additionally, immediately prior to final inspection, the Prime Contractor shall:
   1. Clean all surfaces to condition acceptable for immediate occupancy by the Owner.
   2. Remove all marks, stains, fingerprints, paint droppings and other foreign matter from all finished surfaces.
   3. Clean and polish all hardware.
   4. Wash and polish all glass, including mirrors. Replace cracked, scratched or damaged glass items.
   5. Vacuum all carpeting.

F. Leave premises clean in all respects, ready for use and occupancy by the Owner without additional work.

G. As used herein, the term “premises” shall include all areas within and outside the construction limits which have been soiled, littered or disturbed in any manner by the Work of the Project.

1.8 CONTRACT LIMITS AND PROTECTION OF EXISTING CONDITIONS

A. Use of Site: Limit use of Project site to areas within the Contract limits indicated or implied. Do not disturb portions of Project site beyond areas in which the Work is indicated.

B. Existing property, buildings, walks, curbs, trees, shrubs, lawns, boulevards and the Work of other Contractors, which are damaged or disturbed outside the contract limits, shall be restored to original condition or better. Contractor shall be responsible for the damage or disturbance and shall restore disturbed lawn areas with sod and replace damaged trees and shrubs.

1.9 WORK RESTRICTIONS

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

B. Controlled Substances: Use of tobacco products and other controlled substances, within the building or on the work site, is not permitted.

1.10 PROTECTION OF FINISHED EXPOSED FLOORS AND WALKS
A. Exercise care to prevent damage to exposed, finished floor and walk surfaces during the course of construction of the Project. Remove all spills or smears immediately and sweep floors frequently.

B. Instruct all workmen and deliverymen to exercise caution against accidental damage to the floors and walks by actions such as dropping heavy objects like tools and products, or scratching by sliding objects, or scoring by vibration from metal legs of stand mounted power tools, or permanent discoloration from oil dripping from pipe thread cutting machine, or the like.

C. Avoid using areas with exposed floors and walks as workshops or in any other way which would damage the finished surfaces. When rooms or areas must be so used, cover floor with 5/8 inch thick plywood panels fastened together and underlain with a protective membrane.

D. Assume responsibility for floors being in like new condition upon completion of the Project.

1.11 EXPLOSIVES

A. Use of explosives, for any purpose, is prohibited.

1.12 CONSTRUCTION DOCUMENTS REQUIRED FOR THE WORK

A. The General Contractor shall be responsible for the costs of plan and project manual reproduction and distribution as required for construction, including those required by the subcontractors and suppliers.

B. The General Contractor shall be responsible for the costs of reproduction and distribution of Construction Bulletins (CBs) issued during the course of construction. The A/E will provide CBs in PDF format to the General Contractor.

C. The General Contractor is not responsible for printing construction document plans, project manuals, or CBs for use by the Owner or A/E.
SECTION 01 2200 – UNIT PRICES

PART 1 – GENERAL

1.1 DESCRIPTION

A. Unit prices shall be used in determining additions to or deductions from the Contract amount when changes in the Work as shown on the Drawings or in the Project Manual are directed. They will apply only when the changes involve materials, specifications, methods and designs that are the same as those required in the work shown and/or specified. This will not be applied to changes requiring the use of materials, specifications, methods or design of different character from those shown or specified. The unit prices shall allow for all of Contractor’s costs, including overhead and profit.

1.2 SCHEDULE OF UNIT PRICES FOR GENERAL CONSTRUCTION WORK

A. Unit Price UP-1: (Excess Excavation)

1. State the amount per cubic yard to add or delete removal of unsuitable soil, in place, as specified in Section 31 2000 Earth Moving, and the Geotechnical Report by Edge Consulting Engineers, Inc., dated May 9, 2019 (immediately following Section 00 2000). Such amount shall include legal removal of said soil from the Project Site.

B. Unit Price UP-2: (Compacted Imported Fill)

1. State the amount per cubic yard to add or delete compacted fill, in place, as specified in Section 31 2000 Earth Moving, and the Geotechnical Report by Edge Consulting Engineers, Inc., dated May 9, 2019 (immediately following Section 00 2000).

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

END OF SECTION 01 2200
SECTION 01 2400 – CHANGE ORDER PROCEDURE

PART 1 – GENERAL

1.1 DESCRIPTION

A. Make such changes in the Contract Sum, in the Contract Time of Completion or any combination thereof, as are described in written Change Orders signed by the Owner and issued after execution of the Contract, in accordance with the provisions of this Section.

B. Conditions of the contract and pertinent portions of sections in Division 01 of this Project Manual, apply to the Work of this Section as fully as though repeated herein.

1.2 QUALITY ASSURANCE

A. Include within the quality assurance program such measures as are needed to assure familiarity of the contractor’s staff and employees with these procedures for processing Bulletin and Change order data.

1.3 SUBMITTALS

A. All contractual changes shall be on forms similar to the AIA Change Order form.

B. Make submittals directly to Architect/Engineer at the address shown on the Title Page in the Project Manual.

C. Submit the number of copies called for under the various items listed in this Section.

1.4 PRODUCT HANDLING

A. Maintain a Register of Construction Bulletins (CB) and Change Orders at the job site, accurately reflecting current status of all pertinent data.

B. Make the Register available for review upon request.

1.5 PROCESSING CHANGES INITIATED BY THE OWNER AND/OR AE

A. Should the Owner contemplate making a change in the Work or a change in the Contract Time of Completion, the Architect/Engineer, upon Owner direction, will issue a CB to the Contractor.

   1. CBs will be dated and will be numbered in sequence.
   2. The CB will describe the contemplated change.
      a. Promptly advise Architect/Engineer as to credit or cost and time required proposed for the described change.
         This is not an authorization to proceed with the change.

B. If the Contractor has been directed by Architect/Engineer to make the described change in the Work at no change in the Contract Sum and no change in the Contract Time of Completion, but the Contractor wishes to make a claim for one or both of such changes, the Contractor shall proceed with the change and shall notify the Architect/Engineer as provided for under Article 7 of the General Conditions.

C. If the Contractor has been directed by Architect/Engineer to make the described change subject to later determination of cost or credit in accordance with Article 7 of the General Conditions, the Contractor shall:

   1. Take such measures as needed to make the change.
   2. Consult with Architect/Engineer and reach agreement on the most appropriate method for determining credit or cost for the change.
1.6 PROCESSING CHANGES INITIATED BY THE CONTRACTOR

A. Should the Contractor discover a discrepancy among the Contract Documents, a concealed condition or other cause for suggesting a change in the Work, a change in the Contract Sum or a change in the Contract Time of Completion, he shall notify Architect/Engineer as required by pertinent provisions of the contract Documents.

B. Upon agreement by Architect/Engineer that there is reasonable cause to consider the Contractor’s proposed change, Architect/Engineer will issue a CB in accordance with the provisions described in Article 1.5 above.

1.7 PROCESSING CONSTRUCTION BULLETINS

A. Make written reply to Architect/Engineer in response to each CB by date stated on the Bulletin:

1. State proposed change in the Contract Sum, if any.
2. State proposed change in the Contract Time of Completion, if any.
3. Clearly describe other changes in the Work required by the proposed change or desirable therewith, if any.
4. Include full backup data such as subcontractor’s letter of proposal or similar information.

B. When cost or credit for the proposed change has been agreed upon by the Owner and the Contractor. Or the Owner has directed that cost or credit be determined in accordance with provision of Article 7 of the General Conditions, A/E will notify Contractor in writing. A formal Change Order will be initiated and executed at the time of completion of the Contract or at a time when the payment for work completed is due. All approved CBs previously not incorporated into the contract by a Change Order, shall be combined into a Change Order to adjust the final Contract Sum to compensate for all changes in the Work to date.

1.8 PROCESSING CHANGE ORDERS

A. Change Orders will be dated and will be numbered in sequence.

B. The Change Order will describe the change, or changes, will refer to the Construction Bulletin or Bulletins involved, and will be endorsed by A/E and signed by the contractor and the Owner.

C. Architect/Engineer will issue three copies of each Change Order to the Owner.

1. The contractor promptly shall sign all three copies and return all copies to the A/E.
2. A/E shall forward the Change Order to the Owner for his signature. Upon approval, he shall distribute two fully executed copies of the Change Order to A/E. A/E to distribute one to the Contractor.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION – Not Used

END OF SECTION 01 2400
SECTION 01 2500 – PRODUCT SUBSTITUTIONS

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for substitutions.

B. Related Requirements:

1. Section 01 6000 “Product Requirements” for requirements for submitting comparable product submittals for products by listed manufacturers.

1.1 CONTRACTOR’S OPTIONS

A. Products specified only by reference standards, select any product meeting standards.

B. Where multiple manufacturers/models specified, select any one named.

1.2 SUBSTITUTIONS

A. Provide sufficient data for Architect/Engineer to review. Include manufacturer’s literature, samples, and data relating to construction schedules.

B. Where the Contractor chooses to use an item approved as above, but other than the one shown on the details or specified in detail, he shall be responsible for coordinating any necessary changes in other Work and shall bear the cost of such changes.

C. The Architect/Engineer’s approval of an item for a previous Project does not constitute approval for this Project.

D. Substitutions for convenience are not allowed.

E. All product substitutions require pre-approval by the Architect.
SUBSTITUTION REQUEST FORM

TO: _____________________________________________________________ (Project Manager)
Dimension IV – Madison, LLC
6515 Grand Teton Plaza, Suite 120
Madison, WI 53719
Phone: (608) 829-4444
Fax: (608) 829-4445

SPECIFIED ITEM: __________________________________________   SECTION: __________________________
The undersigned requests consideration of the following:

PROPOSED SUBSTITUTION: _____________________________________________________________________

1. Attached data includes product description, specifications, drawings, photographs, performance and test data adequate for evaluation of the request; applicable portions of the data are clearly identified.
2. Reference standards and test results shall be fully explained and comparable to specified product data.
3. Attached data also includes description of changes to Contract Documents which proposed substitution will require for its proper installation.

The undersigned states that the following paragraphs, unless modified on attachments are correct:
1. The proposed substitution does not affect dimensions shown on Drawings.
2. The undersigned will pay for changes to the building design, including Architectural/Engineering design, detailing and construction costs caused by the requested substitution.
3. The proposed substitution will have no adverse affect on other trades, the construction schedule or specified warranty requirements.

The undersigned further states that the function, appearance and quality of the Proposed Substitution are equivalent or superior to the Specified Item.

Submitted By:

Signature: _________________________________________________
Firm: _____________________________________________________
Address___________________________________________________

By:  ______________________________________________________
Date: _____________________________________________________
Fax: ______________________________________________________

Attachments:

For use by Dimension IV – Madison, LLC
___Accepted   ___ Accepted as Noted
___ Not Accepted   ___ Received Too Late

END OF SECTION 01 2500
SECTION 01 2600 – CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SUMMARY
   A. This Section specifies administrative and procedural requirements for handling and processing Contract modifications.

1.2 MINOR CHANGES IN THE WORK
   A. Architect will issue supplemental instructions authorizing Minor Changes in the Work, not involving adjustment to the Contract Sum or the Contract Time, on AIA Document G710, "Architect's Supplemental Instructions."

1.3 PROPOSAL REQUESTS
   A. Owner-Initiated Proposal Requests: Architect will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
   1. Proposal Requests issued by Architect are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
   2. After receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
      a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      c. Include costs of labor and supervision directly attributable to the change.
      d. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
   B. Contractor-Initiated Proposals: If latent or unforeseen conditions require modifications to the Contract, Contractor may propose changes by submitting a request for a change to Architect.
      1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
      2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
      3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
      4. Include costs of labor and supervision directly attributable to the change.
      5. Include an updated Contractor's Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
      6. Comply with requirements in Division 1 Section "Product Requirements" if the proposed change requires substitution of one product or system for product or system specified.
1.4 CHANGE ORDER PROCEDURES


   B. Refer to Division 01 Section “Change Order Procedure.”

1.5 CONSTRUCTION CHANGE DIRECTIVE


   1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.

   B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.

       1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2600
1.1 SUMMARY
A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.

1.2 SCHEDULE OF VALUES
A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule.

1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including Application for Payment forms with Continuation Sheets, and Contractor's Construction Schedule.
2. Submit the Schedule of Values to Owner’s Representative at earliest possible date but no later than seven days before the date scheduled for submittal of initial Applications for Payment.

B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values. Provide at least one line item for each Specification Section.

1. Identification: Include the following Project identification on the Schedule of Values:
   a. Project name and location.
   b. Name of Architect.
   c. Architect's project number.
   d. Contractor's name and address.
   e. Date of submittal.

2. Arrange schedule of values consistent with format of AIA Document G703.
3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents.
4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
5. Provide a separate line item in the Schedule of Values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
6. Provide separate line items in the Schedule of Values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Each item in the Schedule of Values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.

1.3 APPLICATIONS FOR PAYMENT
A. Each Application for Payment shall be in accordance with the terms of the contract. An amount of 5% of the completed work will be retained until final completion and payment.

1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
B. Payment Application Times: Submit Application for Payment to Architect by the 5th of the month. The period covered by each Application for Payment is one month, ending on the last day of the month.

C. Application for Payment Forms: Use AIA Document G702 and AIA Document G703 as forms for Applications for Payment.

D. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Incomplete applications will be returned without action.
   1. Entries shall match data on the Schedule of Values.
   2. Include amounts of Change Orders issued before last day of construction period covered by application.

E. Transmittal: Submit 3 signed and notarized original copies of each Application for Payment to Architect by a method ensuring receipt within 24 hours. One copy shall include waivers of lien and similar attachments if required.
   1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.

F. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from every entity who is lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
   1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
   2. When an application shows completion of an item, submit conditional final or full waivers.
   3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
   4. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

G. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. List of subcontractors.
   2. Schedule of Values.
   3. Schedule of unit prices.
   4. Submittals schedule (preliminary if not final).
   5. List of Contractor's staff assignments.
   7. Copies of building permits.
   11. Certificates of insurance and insurance policies.

H. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
   1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
   2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

I. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
3. Updated final statement, accounting for final changes to the Contract Sum.
7. Evidence that claims have been settled.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 2900
1.1 SUMMARY

A. This Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
   1. Coordination of the Work.
   2. Requests for Interpretation (RFIs).
   3. Project Meetings.

B. Related Sections include the following:
   1. Division 01 Section “Closeout Procedures” for coordinating closeout of the Contract.
   2. Division 01 Section “Execution” for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control joints.

1.2 DEFINITIONS

A. RFI: Request from Contractor seeking interpretation or clarification of the Contract Documents.

1.3 INFORMATION SUBMITTALS

A. Subcontract List: Prepare a written summary identifying individuals or firms for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Include the following information in tabular form:
   1. Name, address, and telephone number of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.

1.4 GENERAL COORDINATION PROCEDURES

A. Coordination: Coordinate construction operations included in different Sections of the Specifications to ensure efficient and orderly installation of each part of the Work. Coordinate construction operations included in different Sections that depend on each other for proper installation, connection, and operation.
   1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
   2. Coordinate installation of different components to ensure maximum accessibility for required maintenance, service, and repair.
   3. Make adequate provisions to accommodate items scheduled for later installation.
   4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components, including mechanical and electrical.

B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Architect and separate contractors if coordination of their Work is required.
C. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:

1. Preparation of Construction Schedule.
2. Preparation of the Schedule of Values.
3. Installation and removal of temporary facilities and controls.
4. Delivery and processing of submittals.
5. Progress meetings.
6. Preinstallation conferences.
7. Project closeout activities.
8. Startup and adjustment of systems.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.5 REQUESTS FOR INFORMATION (RFIs)

A. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit an RFI in the form specified.

1. Architect will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor’s work.

B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:

1. Project Name.
2. Project Number.
3. Date.
4. Name of Contractor.
5. Name of Architect.
6. RFI Number, numbered sequentially.
7. RFI Subject.
8. Specification Section number and title and related paragraphs, as appropriate.
9. Drawing Number and detail references, as appropriate.
10. Field dimensions and conditions, as appropriate.
11. Contractor’s suggested resolution. If Contractor’s solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
12. Contractor’s Signature.
13. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
   a. Supplementary drawings prepared by Contractor shall include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments.

C. Architect’s Action: Architect will review each RFI, determine action required, and respond. Allow seven working days for Architect’s response for each RFI. RFIs received by Architect after 1:00 p.m. will be considered as received the following working day.

1. The following RFIs will be returned without action:
   a. Requests for approvals of submittals.
   b. Requests for approval of substitutions.
   c. Requests for coordination information already indicated in the Contract Documents.
d. Requests for adjustments in the Contract Time or the Contract Sum.

e. Requests for interpretation of Architect’s actions on submittals.

f. Incomplete RFIs or inaccurately prepared RFIs.

2. Architect’s action may include a request for additional information, in which case Architect’s time for response will date from time of receipt of additional information.

3. Architect’s action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Section 01 2600 “Contract Modification Procedures.”

   a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Architect in writing within 10 days of receipt of the RFI response.

D. On receipt of Architect’s action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Architect within seven days if Contractor disagrees with response.

E. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by RFI number.

   1. Project Name.
   2. Name and address of Contractor.
   3. Name and address of Architect.
   4. RFI Number, including RFIs that were dropped and not submitted.
   5. RFI Description.
   6. Date the RFI was submitted.
   7. Date Architect’s response was received.
   8. Identification of related Minor Change in the Work, Construction Change Directive, and Proposal Request, as appropriate.

1.6 PROJECT MEETINGS

A. General: Schedule and conduct meetings and conferences at Project site, unless otherwise indicated.

B. Project Meetings will be held weekly. Contractor shall schedule additional meetings with workers and subcontractors as needed to ensure the project is completed on schedule.

C. For those persons designated by the Contractor to attend and participate in project meetings, provide required authority to commit to solutions agreed upon in the project meetings.

   1. Assign the same person or persons to attend project meetings throughout progress of the Work.
   2. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Architect of scheduled meeting times and dates.
   3. Prepare the meeting agenda; distribute the agenda to all invited parties. Minimum agenda:
      a. Review, revise as necessary and approve minutes of previous meetings.
      b. Review progress of the Work since last meeting, including status of submittals for approval.
      c. Identify problems which impede planned progress.
      d. Develop corrective measures and procedures to regain planned schedule.
      e. Complete other current business.
   4. Minutes: Record significant discussions and agreements achieved. Distribute the meeting minutes to everyone concerned, including Owner and Architect, within three (3) days of the meeting.
   5. Revisions to Minutes:
      a. Unless published minutes are challenged in writing prior to the next regularly scheduled project meeting, they will be accepted as properly stating the activities and decisions of the meeting.
b. Persons challenging published minutes shall reproduce and distribute copies of the challenge to all indicated recipients of the particular set of minutes.

c. Challenges to minutes shall be settled as priority portion of old business at the next regularly scheduled meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 01 3100
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:

1. Contractor’s Construction Schedule.
2. Submittals Schedule.
3. Daily construction reports.
4. Field condition reports.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.

1. Critical activities must start and finish on the planned early start and finish times.
2. Predecessor Activity: An activity that precedes another activity in the network.
3. Successor Activity: An activity that follows another activity in the network.

B. Float: The measure of leeway in starting and completing an activity.

1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date.

C. Major Area: A story of construction, a separate building, or a similar significant construction element.

1.3 SUBMITTALS

A. Submittals Schedule: Submit three copies of schedule. Arrange the following information in a tabular format:

1. Scheduled date for first submittal.
2. Specification Section number and title.
3. Submittal category (action or informational).
4. Name of subcontractor.
5. Description of the Work covered.
6. Scheduled date for Architect’s final release or approval.

B. General Contractor’s Construction Schedule: Submit two opaque copies of initial schedule, large enough to show entire schedule for entire construction period.

1. Submit an electronic copy of schedule.

C. Daily Construction Reports: Submit at weekly intervals.

D. Field Condition Reports: Submit at time of discovery of differing conditions.
1.4 COORDINATION

A. Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors.

B. Coordinate General Contractor's Construction Schedule with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from parties involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 SUBMITTALS SCHEDULE

A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.

2.2 GENERAL CONTRACTOR'S CONSTRUCTION SCHEDULE, GENERAL

A. Time Frame: Extend schedule from date established in the Notice to Proceed to date of Substantial Completion.
   1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

B. Activities: Treat each story or separate area as a separate numbered activity for each principal element of the Work. Comply with the following:
   1. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by Architect.
   2. Procurement Activities: Include procurement process activities for the following long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
   3. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section "Submittal Procedures" in schedule. Coordinate submittal review times in General Contractor's Construction Schedule with Submittals Schedule.
   4. Startup and Testing Time: Include not less than 7 days for startup and testing.
   5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for Architect's and General Contractor's preparation of punch lists and administrative procedures necessary for certification of Substantial Completion.

C. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
   1. Phasing: Arrange list of activities on schedule by phase.
   2. Work under More Than One Contract: Include a separate activity for each contract.
   3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
   4. Work Restrictions: Show the effect of the following items on the schedule:
      a. Coordination with existing construction.
      b. Limitations of continued occupancies.
      c. Uninterruptible services.
      d. Partial occupancy before Substantial Completion.
5. Work Stages: Indicate important stages of construction for each major portion of the Work.

D. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion.

E. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis to demonstrate the effect of the proposed change on the overall project schedule.

F. Upcoming Work Summary: Prepare summary report indicating activities scheduled to occur or commence prior to submittal of next scheduled update. Summarize the following issues:

1. Unresolved issues.
2. Unanswered Requests for Information.
3. Rejected or unreturned submittals.
4. Notations on returned submittals.

G. Recovery Schedule: When periodic updates indicate the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule.

2.3 GENERAL CONTRACTOR'S CONSTRUCTION SCHEDULE

A. Submit a comprehensive, fully developed, horizontal, General Contractor's Construction Schedule within 10 days of date established for the Notice to Proceed. Base schedule on the Preliminary Construction Schedule and whatever updating and feedback was received since the start of Project.

B. Preparation: Indicate each significant construction activity separately.

C. Initial Issue of Schedule: Prepare from a list of straight "early start-total float" sort. Identify critical activities. Prepare tabulated reports showing the following:

1. Contractor or subcontractor and the Work or activity.
2. Description of activity.
3. Principal events of activity.
4. Immediate preceding and succeeding activities.
5. Early and late start dates.
6. Early and late finish dates.
7. Activity duration in workdays.
8. Total float or slack time.

D. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:

1. Identification of activities that have changed.
2. Changes in early and late start dates.
3. Changes in early and late finish dates.
5. Changes in the critical path.
6. Changes in total float or slack time.
2.4 REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:

1. List of subcontractors at Project site.
2. Equipment at Project site.
3. Material deliveries.
4. High and low temperatures and general weather conditions.
5. Accidents.
6. Meetings and significant decisions.
7. Unusual events.
8. Stoppages, delays, shortages, and losses.
9. Meter readings and similar recordings.
10. Orders and requests of authorities having jurisdiction.
11. Change orders received and implemented.
12. Change directives received and implemented.
13. Services connected and disconnected.
14. Equipment or system tests and startups.
15. Partial completions and occupancies.
16. Substantial Completion authorized.

B. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare and submit a detailed report. Submit with a request for interpretation or RFI. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

PART 3 - EXECUTION

3.1 GENERAL CONTRACTOR'S CONSTRUCTION SCHEDULE

A. General Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue schedule one week before each regularly scheduled progress meeting.

1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
3. As the Work progresses, indicate Actual Completion percentage for each activity.

B. Distribution: Distribute copies of approved schedule to Architect Owner, separate contractors, testing and inspecting agencies, and other parties identified by General Contractor with a need-to-know schedule responsibility.

1. Post copies in Project meeting rooms and temporary field offices.
2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 01 3200
PART 1 – GENERAL

1.1 SUBMITTALS

A. Within 10 days after Award of Contract and before any items are submitted for approval, submit to Owner's Representative two copies of the schedule description in Article 2.1 of this section.

B. Submittals shall be made identifying document or section number and title. Each item shall be identified separately on the transmittal.

PART 2 – PRODUCTS

2.1 SHOP DRAWINGS AND SUBMITTALS LOG

A. Compile a complete and comprehensive schedule of all submittals anticipated to be made during progress of the work. Include a list of each type of item for which Contractor's drawings, shop drawings, material samples, guarantees or other types of submittals are required.

2.2 SUBCONTRACTORS AND SUPPLIERS SCHEDULE

A. Within 10 days after notification of selection for award of contract, provide a listing of major subcontractors; include their address, phone number and the portions of work which they will perform.

B. Within 30 days after notification of selection for award of contract, provide a listing of suppliers and manufacturers; include their address, phone number and the portions of work which they will perform.

2.3 SHOP DRAWINGS AND COORDINATION DRAWINGS

A. Shop Drawings.

1. Make to a scale sufficiently large to show all pertinent aspects of the item and its method of connection.
2. Submit one (1) copy of shop drawings via email using PDF format.
   a. A/E will keep one copy for A/E file and provide one copy in PDF format for owner.
   b. A/E will forward one copy with review comments in PDF format via email to general contractor.
3. All review comments of A/E will be shown on the shop drawing copy returned to contractor. Contractor: make and distribute all copies required for his purposes.
4. Shop drawings shall be prepared specifically for this project. No reproduction of A/E’s drawings will be accepted.

B. Shop Drawing Approvals.

1. Reviewing and conditional approval are only for conformance with the design concept of the project and compliance with the information given in the contract documents.
2. Conditions of Approval: The Contractor is responsible for dimensions to be confirmed and correlated at the site; for information that pertains solely to the fabrication process or to the means, methods, techniques, sequences and procedures of construction and for coordination of the work of all trades. Corrections or comments made on this shop drawing submittal do not relieve the Contractor from compliance with requirements of contract documents.
2.4 PRODUCT DATA

A. Where contents of submitted product data includes data not pertinent to the submittal, clearly indicate which portion of the contents is being submitted for review.

2.5 SAMPLES

A. Samples shall be of the precise article proposed to be furnished.

B. Submit all samples in the quantity which is required to be returned plus two which will be retained by A/E.

C. In situations specifically so approved by A/E, A/E’s retained sample may be used in the construction as one of the installed items.

D. Unless the precise color and pattern is specifically described in the contract documents and wherever a choice of color or pattern is available in a specified product, submit accurate color and pattern charts to A/E for review and selection.

2.6 PROGRESS SCHEDULES

A. Based on the preliminary development of the progress schedule and on whatever updating and feedback may have occurred during the project start-up, secure critical time commitments for performing elements of the work. Within 30 days of the date established for commencement of the work, submit a comprehensive schedule. Prepare and maintain the schedule to show the required data clearly for the entire construction time. Update the progress schedule at monthly or shorter time intervals.

B. Coordinate the schedule with all necessary subcontractors and materials suppliers to ensure their understanding of the importance of adhering to the approved schedule.

C. Revise and update the schedule on a monthly basis as necessary to reflect conditions and sequences. Promptly submit revised schedules to A/E for review and comment.

2.7 SCHEDULE OF VALUES

A. Prepare the Schedule of Values required by the General Conditions, in conjunction with the preparation of the Progress Schedule. Correlate line items with other administrative schedules and forms required for the work.

B. Submit the Schedule of Values to A/E no later than 10 days before submission of the first Application for Payment. Refer to the Supplementary Conditions for detail of format and content of Schedule of Values.

C. Cost breakdown shall be on a product section-by-product section basis. Dollar value shall be rounded off to the nearest $10.

D. Cost breakdown will be used for project completion percentages only.

2.8 MISCELLANEOUS SUBMITTALS

A. Test Reports and Data: Submit test reports and data to the A/E according to Section 01 400 and elsewhere in the project specifications.

B. Guarantees, Warranties, Certificates, Operating Instructions and Maintenance Instructions: Submit all such items to the Owner thru the A/E as required by Section 01 7700 and others as applicable.

C. Consent of Surety Form: Contractor request for final payment shall be accompanied by a properly executed copy of Document 00 6220 Consent of Surety to Final Payment as bound in this Project Manual.
D. Warranties: Provide standard warranty for 1 year parts and labor.

2.9 FINAL SUBMITTALS

A. Final submittal shall be in accordance with Section 01 7700 Closeout Procedures.

PART 3 – EXECUTION

3.1 TIMING OF SUBMITTALS

A. Make all submittals far enough in advance of scheduled dates for installation to provide all time required for reviews, for securing necessary approvals, for possible revisions and resubmittals and for placing orders and securing delivery. Submit written substitution requests to the A/E at least 10 days prior to bid due date. Requests received after this time will not be considered.

B. In scheduling, allow at least 10 calendar days for review by A/E following his receipt of the submittal.

C. Delays caused by tardiness in receipt of submittals will not be an acceptable basis for extension of the contract completion date.

END OF SECTION 01 3300
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.

1. Specified tests, inspections, and related actions do not limit Contractor's other quality-assurance and -control procedures that facilitate compliance with the Contract Document requirements.

2. Requirements for Contractor to provide quality-assurance and -control services required by Architect, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

C. See Divisions 03 through 28 Sections for specific test and inspection requirements.

1.2 DEFINITIONS

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with requirements. Services do not include contract enforcement activities performed by Architect.

C. Mockups: Full-size, physical assemblies that are constructed on-site. Mockups are used to verify selections made under sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Approved mockups establish the standard by which the Work will be judged.

D. Laboratory Mockups: Full-size, physical assemblies that are constructed at testing facility to verify performance characteristics.

E. Preconstruction Testing: Tests and inspections that are performed specifically for the Project before products and materials are incorporated into the Work to verify performance or compliance with specified criteria.

F. Product Testing: Tests and inspections that are performed by an NRTL, an NVLAP, or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with industry standards.

G. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.

H. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.

I. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
J. **Installer/Applicator/Erector:** Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.

1. Using a term such as "carpentry" does not imply that certain construction activities must be performed by accredited or unionized individuals of a corresponding generic name, such as "carpenter." It also does not imply that requirements specified apply exclusively to trades people of the corresponding generic name.

K. **Experienced:** When used with an entity, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

### 1.3 CONFLICTING REQUIREMENTS

A. **General:** If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainties and requirements that are different, but apparently equal, to Architect for a decision before proceeding.

B. **Minimum Quantity or Quality Levels:** The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Architect for a decision before proceeding.

### 1.4 SUBMITTALS

A. **Qualification Data:** For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. **Reports:** Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Record of temperature and weather conditions at time of sample taking and testing and inspecting.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Document requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspecting.

C. **Permits, Licenses, and Certificates:** For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.
1.5  QUALITY ASSURANCE

A. General: Qualifications paragraphs in this Article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.

B. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

C. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

D. Manufacturer’s Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer’s products that are similar in material, design, and extent to those indicated for this project.

E. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

F. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or products that are similar to those indicated for this Project in material, design, and extent.

G. Specialists: Certain sections of the Specifications require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialists shall not supersed building codes and regulations governing the Work.

H. Testing Agency Qualifications: An NRTL, an NVLAP, or an independent agency with the experience and capability to conduct testing and inspecting indicated, as documented according to ASTM E 548; and with additional qualifications specified in individual Sections; and where required by authorities having jurisdiction, that is acceptable to authorities.

1. NRTL: A nationally recognized testing laboratory according to 29 CFR 1910.7.
2. NVLAP: A testing agency accredited according to NIST’s National Voluntary Laboratory Accreditation Program.

I. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer’s products that are similar in material, design, and extent to those indicated for this Project.

J. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and of size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Architect’s approval of mockups before starting work, fabrication, or construction.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed, unless otherwise indicated.
1.6 QUALITY CONTROL

A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.

1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
2. Costs for retesting and reinspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor, and the Contract Sum will be adjusted by Change Order.

B. Tests and inspections not explicitly assigned to Owner are Contractor's responsibility. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
   a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
2. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspecting will be performed.
3. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
4. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
5. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

C. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing as specified in Division 01 Section "Submittal Procedures."

D. Retesting/Reinspecting: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspecting, for construction that replaced Work that failed to comply with the Contract Documents.


1. Notify Architect and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
6. Do not perform any duties of Contractor.

F. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
4. Facilities for storage and field curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspecting equipment at Project site.

G. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and -control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.

1. Schedule times for tests, inspections, obtaining samples, and similar activities.

1.7 SPECIAL TESTS AND INSPECTIONS

A. Special Tests and Inspections: Owner will engage a qualified testing agency to conduct special tests and inspections required by authorities having jurisdiction as the responsibility of Owner, and as follows:

1. Verifying that manufacturer maintains detailed fabrication and quality-control procedures and reviewing the completeness and adequacy of those procedures to perform the Work.
2. Notifying Architect and Contractor promptly of irregularities and deficiencies observed in the Work during performance of its services.
3. Submitting a certified written report of each test, inspection, and similar quality-control service to Architect with copy to Contractor and to authorities having jurisdiction.
4. Submitting a final report of special tests and inspections at Substantial Completion, which includes a list of unresolved deficiencies.
5. Interpreting tests and inspections and stating in each report whether tested and inspected work complies with or deviates from the Contract Documents.
6. Retesting and reinspecting corrected work.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Provide materials and comply with installation requirements specified in other Specification Sections. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible.
2. Comply with the Contract Document requirements for Division 01 Section "Cutting and Patching."

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

END OF SECTION 01 4000
SECTION 01 4200 – REFERENCES

PART 1 – GENERAL

1.1 SUMMARY

A. This Section specifies administrative requirements for compliance with standards.

1. Refer to General and Supplementary Conditions for requirements for compliance with governing regulations.

1.2 DEFINITIONS

A. Indicated refers to graphic representations, notes or schedules on the Drawings or other Paragraphs or Schedules in Specifications and similar requirements in Contract Documents. Where terms such as shown, noted, scheduled and specified are used, it is to help locate the reference; no limitation on location is intended except as specifically noted.

B. The term furnish is used to mean supply and deliver to the project site, ready for unloading, unpacking, assembly, installation and similar operations.

C. The term install is used to describe operations at project site including the actual unloading, unpacking, assembly, erection, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning and similar operations.

D. The term “provide” means to furnish and install, complete and ready for the intended use.

1.3 INDUSTRY STANDARDS

A. Trade association names and titles of general standards are frequently abbreviated. The following acronyms or abbreviations as referenced in Contract Documents are defined to mean the associated names. Names and addresses are subject to change and are believed to be, but are not assured to be, accurate and up-to-date as of date of Contract Documents.

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<tr>
<th>Acronym</th>
<th>Name</th>
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<td>AA</td>
<td>ALUMINUM ASSOCIATION</td>
<td>818 Connecticut Avenue, N.W.</td>
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<td>Washington, DC 20006</td>
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<td>AABC</td>
<td>ASSOCIATED AIR BALANCE COUNCIL</td>
<td>100 Vermont Avenue, N.W.</td>
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<td>Washington, DC 20005</td>
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<td>ACI</td>
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<td>AISI</td>
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<td>1000 16th Street, N.W.</td>
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<td>Tacoma, WI 98411</td>
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<td>ARI</td>
<td>AIR CONDITIONING &amp; REFRIGERATION INSTITUTE</td>
<td>1815 North Fort Myer Drive</td>
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<td>Arlington, VA 22209</td>
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<td>ASHRAE</td>
<td>AMERICAN SOCIETY OF HEATING, REFRIGERATION</td>
<td>345 East 47th Street</td>
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<td>&amp; AIR CONDITIONING ENGINEERS</td>
<td>New York, NY 10017</td>
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<td>Philadelphia, PA 19103</td>
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<td>AWI</td>
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<td>AWPA</td>
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<td>AWS</td>
<td>AMERICAN WELDING SOCIETY</td>
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SSPC
STEEL STRUCTURES PAINTING COUNCIL
4400 Fifth Avenue
Pittsburgh, PA 15213

TCA
TILE COUNCIL OF AMERICA, INC.
Box 326
Princeton, NJ 08540

UL
UNDERWRITER'S LABORATORIES, INC.
333 Pfingston Road
Northbrook, IL 60062

END OF SECTION 01 4200
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes requirements for temporary utilities, support facilities, and security and protection facilities.

B. See Division 01 Section "Execution Requirements" for progress cleaning requirements.

C. See Divisions 03 through 26 Sections for temporary heat, ventilation, and humidity requirements for products in those Sections.

1.2 DEFINITIONS

A. Permanent Enclosure: As determined by Architect, permanent or temporary roofing is complete, insulated, and weather tight; exterior walls are insulated and weather tight; and all openings are closed with permanent construction or substantial temporary closures.

1.3 SUBMITTALS

A. Site Plan: Show temporary facilities, utility hookups, staging areas, and parking areas for construction personnel.

1.4 USE CHARGES

A. General: Cost or use charges for temporary facilities shall be included in the Contract Sum. Allow other entities to use temporary services and facilities without cost, including, but not limited to, Owner's construction forces, Architect, occupants of Project, testing agencies, and authorities having jurisdiction.

1.5 JOB CONDITIONS

A. Establish and initiate use of each temporary facility at time first reasonably required for proper performance of the work. Terminate use and remove facilities at earliest reasonable time, when no longer needed or when permanent facilities have, with authorized use, replaced the need.

B. Conditions of Use: Install, operate, maintain and protect temporary facilities in a manner and at locations which will be safe, non-hazardous, sanitary and protective of persons and property and free of deleterious effects.

1.6 QUALITY ASSURANCE

A. Electric Service: Comply with NECA, NEMA, and UL standards and regulations for temporary electric service. Install service to comply with NFPA 70.

B. Tests and Inspections: Arrange for authorities having jurisdiction to test and inspect each temporary utility before use. Obtain required certifications and permits.
1.7 PROJECT CONDITIONS

A. Temporary Use of Permanent Facilities: Installer of each permanent service shall assume responsibility for operation, maintenance, and protection of each permanent service during its use as a construction facility before Owner’s acceptance, regardless of previously assigned responsibilities.

PART 2 - PRODUCTS

2.1 TEMPORARY FACILITIES

A. Field Offices, General: Prefabricated or mobile units with serviceable finishes, temperature controls, and foundations adequate for normal loading.

B. Storage and Fabrication Sheds: Provide sheds sized, furnished, and equipped to accommodate materials and equipment for construction operations.

2.2 WEATHER PROTECTION – ALL SUBCONTRACTORS

A. Protect material, apparatus, fixtures and the work from damage by wind, freezing and precipitation while in shipment, storage and in place. Cover and otherwise protect each day’s work susceptible to weather damage.

B. Keep equipment and surroundings in a clean, safe condition. Tarpaulins and other materials used for temporary enclosure of space shall be flame resistant.

C. Conditions of Use: Install, operate, maintain and protect temporary facilities in a manner and at locations which will be safe, non-hazardous, sanitary and protective of persons and property and free of deleterious effects.

2.3 EQUIPMENT

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. HVAC Equipment: General Contractor shall provide vented, self-contained, liquid-propane-gas or fuel-oil heaters with individual space thermostatic control.

   1. Use of gasoline-burning space heaters, open-flame heaters, or salamander-type heating units is prohibited.
   2. Heating Units: Listed and labeled for type of fuel being consumed, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
   3. Permanent HVAC System: If Owner authorizes use of permanent HVAC system for temporary use during construction, provide filter with MERV of 8 at each return air grille in system and remove at end of construction.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required by progress of the Work.

   1. Locate facilities to limit site disturbance as specified in Division 01 Section “Summary of the Work.”
B. Provide each facility ready for use when needed to avoid delay. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 TEMPORARY UTILITY INSTALLATION

A. General: Install temporary service.
   1. Arrange with utility company for time when service can be interrupted, if necessary, to make connections for temporary services.

B. Water Service: Install water service and distribution piping in sizes and pressures adequate for construction.

C. Sanitary Facilities: Provide temporary toilets, wash facilities, and drinking water for use of construction personnel. Comply with authorities having jurisdiction for type, number, location, operation, and maintenance of fixtures and facilities.

D. Heating and Cooling: General Contractor will provide temporary heating and cooling required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of low temperatures or high humidity.

E. Ventilation and Humidity Control: General Contractor will provide temporary ventilation required by construction activities for curing or drying of completed installations or for protecting installed construction from adverse effects of high humidity. Select equipment that will not have a harmful effect on completed installations or elements being installed. Coordinate ventilation requirements to produce ambient condition required and minimize energy consumption.

F. Electric Power Service: Provide electric power service and distribution system of sufficient size, capacity, and power characteristics required for construction operations.

G. Lighting: Provide temporary lighting with local switching that provides adequate illumination for construction operations, observations, inspections, and traffic conditions.
   1. Install and operate temporary lighting that fulfills security and protection requirements without operating entire system.

H. Telephone Service: Provide temporary telephone service in common-use facilities for use by all construction personnel. Install one telephone line for each field office.
   1. Provide additional telephone lines for the following:
      a. Provide a dedicated telephone line for each facsimile machine and computer in each field office.
      2. At each telephone, post a list of important telephone numbers including police and fire departments, Contractor's home office, Architect's office, Owner's office, Principal subcontractors' field and home offices.
      3. Provide superintendent with cellular telephone or portable two-way radio for use when away from field office.

I. Electronic Communication Service: Provide temporary electronic communication service, including electronic mail in field office.

3.3 SUPPORT FACILITIES INSTALLATION

A. General: Comply with the following:
   1. Provide incombustible construction for offices, shops, and sheds located within construction area or within 30 feet of building lines. Comply with NFPA 241.
2. Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

B. Temporary Roads and Paved Areas: Construct and maintain temporary roads and paved areas adequate for construction operations. Locate temporary roads and paved areas within construction limits indicated on Drawings.
   1. Provide dust-control treatment that is nonpolluting and nontracking. Reapply treatment as required to minimize dust.

C. Traffic Controls: Comply with requirements of authorities having jurisdiction.
   1. Protect existing site improvements to remain including curbs, pavement, and utilities.
   2. Maintain access for fire-fighting equipment and access to fire hydrants.

D. Parking: Provide temporary parking areas for construction personnel.

E. Dewatering Facilities and Drains: Comply with requirements of authorities having jurisdiction. Maintain Project site, excavations, and construction free of water.
   1. Dispose of rainwater in a lawful manner that will not result in flooding Project or adjoining properties nor endanger permanent Work or temporary facilities.
   2. Remove snow and ice as required to minimize accumulations.

F. Project Identification and Temporary Signs: Unauthorized signs are not permitted.
   1. Provide temporary, directional signs for construction personnel and visitors.
   2. Maintain and touchup signs so they are legible at all times.

G. Waste Disposal Facilities: Provide waste-collection containers in sizes adequate to handle waste from construction operations. Comply with requirements of authorities having jurisdiction. Comply with Division 01 Section "Execution Requirements" for progress cleaning requirements.

H. Lifts and Hoists: Provide facilities necessary for hoisting materials and personnel.
   1. Truck cranes and similar devices used for hoisting materials are considered “tools and equipment” and not temporary facilities.

I. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

J. Temporary Use of Permanent Stairs: Use of new stairs for construction traffic will be permitted, provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

3.4 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations and that minimize possible air, waterway, and subsoil contamination or pollution or other undesirable effects.

B. Temporary Erosion and Sedimentation Control: Provide measures to prevent soil erosion and discharge of soil-bearing water runoff and airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

C. Stormwater Control: Comply with authorities having jurisdiction. Provide barriers in and around excavations and subgrade construction to prevent flooding by runoff of stormwater from heavy rains.
D. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

E. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Obtain extended warranty for Owner. Perform control operations lawfully, using environmentally safe materials.

F. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

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

H. Barricades, Warning Signs, and Lights: Comply with requirements of authorities having jurisdiction for erecting structurally adequate barricades, including warning signs and lighting.

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

1. Where heating or cooling is needed and permanent enclosure is not complete, insulate temporary enclosures.

J. Temporary Partitions: Provide floor-to-ceiling dustproof partitions to limit dust and dirt migration and to separate areas occupied by Owner and tenants from fumes and noise.

1. Construct dustproof partitions with gypsum wallboard with joints taped on occupied side, and fire-retardant plywood on construction operations side.
2. Construct dustproof partitions with 2 layers of 6-mil polyethylene sheet on each side. Cover floor with 2 layers of 6-mil polyethylene sheet, extending sheets 18 inches up the sidewalls. Overlap and tape full length of joints. Cover floor with fire-retardant plywood.
   a. Construct vestibule and airlock at each entrance through temporary partition with not less than 84 inches between doors. Maintain water-dampened foot mats in vestibule.

3. Insulate partitions to provide noise protection to occupied areas.
4. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
5. Protect air-handling equipment.
7. Provide walk-off mats at each entrance through temporary partition.


1. Prohibit smoking in construction areas.
2. Supervise welding operations, combustion-type temporary heating units, and similar sources of fire ignition according to requirements of authorities having jurisdiction.
3. Develop and supervise an overall fire-prevention and -protection program for personnel at Project site. Review needs with local fire department and establish procedures to be followed. Instruct personnel in methods and procedures. Post warnings and information.
4. Provide temporary standpipes and hoses for fire protection. Hang hoses with a warning sign stating that hoses are for fire-protection purposes only and are not to be removed. Match hose size with outlet size and equip with suitable nozzles.

L. Temporary Existing Floor Protection: Install and maintain temporary floor protection.
1. Pipe threading inside existing building is not permitted.

3.5 MOISTURE AND MOLD CONTROL

A. Contractor’s Moisture Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect materials from water damage and keep porous and organic materials from coming into prolonged contact with concrete.

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Discard or replace water-damaged and wet material.
4. Discard, replace, or clean stored or installed material that begins to grow mold.
5. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes.

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, maintain as follows:

1. Control moisture and humidity inside building by maintaining effective dry-in conditions.
2. Remove materials that cannot be completely restored to their manufactured moisture level within 48 hours.

3.6 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal.

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

C. Temporary Facility Changeover: Do not change over from using temporary security and protection facilities to permanent facilities until Substantial Completion.

D. Termination and Removal: Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary facilities are property of Contractor. Owner reserves right to take possession of Project identification signs.
2. At Substantial Completion, clean and renovate permanent facilities used during construction period. Comply with final cleaning requirements specified in Division 01 Section “Closeout Procedures.”

END OF SECTION 01 1500
PART 1 - GENERAL

1.1 SUMMARY

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

B. Related Requirements:

1. See Division 01 Section “Closeout Procedures” for submitting warranties for Contract closeout.
2. See Division 03 through 26 Sections for specific requirements for warranties on products and installations specified to be warranted.
3. Section 01 2500 “Product Substitutions” for requests for substitutions.

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, except that products consisting of recycled-content materials are allowed, unless explicitly stated otherwise. 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. 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.

1.3 SUBMITTALS

A. Comparable Product 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.

1. Dimension IV – Madison, LLC: If necessary, Dimension IV – Madison will request additional information or documentation for evaluation within one week of receipt of a comparable product request. Dimension IV – Madison will notify Contractor of approval or rejection of proposed comparable product request within 15 days of receipt of request, or 7 days of receipt of additional information or documentation, whichever is later.
a. Form of Approval: As specified in Division 01 Section "Submittal Procedures."
b. Use product specified if Architect cannot make a decision on use of a comparable product request
within time allocated.

B. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 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 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss,
including theft. Comply with manufacturer's written instructions.

B. Delivery and Handling:

1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction
spaces.
2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable,
hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or
other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting,
and installing.
4. Inspect products on delivery to ensure compliance with the Contract Documents and to ensure that products
are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above
ground, with ventilation adequate to prevent condensation.
4. Store cementitious products and materials on elevated platforms.
5. Store foam plastic from exposure to sunlight, except to extent necessary for period of installation and
concealment.
6. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, and weather-
protection requirements for storage.
7. Protect stored products from damage and liquids from freezing.

1.6 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.

1. Manufacturer's Warranty: Preprinted written warranty published by individual manufacturer for a particular
product and specifically endorsed by manufacturer to Owner.
2. 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.

B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.

   1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
   2. Specified Form: When specified forms are included with the Specifications, prepare a written document using appropriate form properly executed.
   3. Refer to Divisions 03 through 28 Sections for specific content requirements and particular requirements for submitting special warranties.

C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

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.

   1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
   2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
   3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
   4. Where products are accompanied by the term "as selected," Architect will make selection.
   5. Where products are accompanied by the term "match sample," sample to be matched is Architect's.

B. Product Selection Procedures:

   1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
   2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
   3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
   4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
   5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
   6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
   7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with Division 01 Section "Product Substitutions" for consideration of an unnamed product or system.
8. **Basis-of-Design Product:** Where Specifications name a product and include a list of manufacturers, provide 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 Part 2 "Comparable Products" Article for consideration of an unnamed product by the other named manufacturers.

9. **Visual Matching Specification:** Where Specifications require matching an established Sample, select a product that complies with requirements and matches Architect's sample. Architect's decision will be final on whether a proposed product matches.

10. **Visual Selection Specification:** Where Specifications include the phrase "as selected from manufacturer's colors, patterns, textures" or a similar phrase, select a product 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, density, 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, density, or texture from manufacturer's product line that includes both standard and premium items.

2.2 **COMPARABLE PRODUCTS**

A. **Conditions:** Architect will consider Contractor's request for comparable product 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. 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.
SECTION 01 7300 – EXECUTION

PART 1 – GENERAL

SUMMARY

A. This Section includes general procedural requirements governing execution of the Work including, but not limited to, the following:

2. Field engineering.
4. Progress cleaning.
5. Starting and adjusting.
6. Protection of installed construction.
7. Correction of the Work.

B. Related Requirements:
   1. Section 01 1000 “Summary of the Work: for limits on use of Project site.
   2. Section 01 7700 “Closeout Procedures” for final cleaning requirements.
   3. Section 01 7329 “Cutting and Patching” for repair and restoration of finishes and surfaces.

1.2 SUBMITTALS

A. Section 01 3300 – Submittal Procedures.

B. Landfill Receipts: Submit copy of receipts issued by a landfill facility, licensed to accept hazardous materials, for hazardous waste disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements in other Sections.

B. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to Architect for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of mechanical and electrical systems and other construction affecting the Work.

1. Before construction, verify the location and points of connection of utility services.
B. Existing Utilities: The existence and location of underground and other utilities and construction indicated as existing are not guaranteed. Before beginning site work, investigate and verify the existence and location of underground utilities and other construction affecting the Work.

1. Before construction, verify the location and invert elevation at points of connection of sanitary sewer, storm sewer, and water-service piping; and underground electrical services.
2. Furnish location data for work related to Project that must be performed by public utilities serving Project site.

C. Acceptance of Conditions: Examine substrates, areas, and conditions, with Installer or Applicator present where indicated, for compliance with requirements for installation tolerances and other conditions affecting performance. Record observations.

1. Verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Examine roughing-in for mechanical and electrical systems to verify actual locations of connections before equipment and fixture installation.
3. Examine walls, floors, and roofs for suitable conditions where products and systems are to be installed.
4. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Existing Utility Information: Furnish information to local utility and Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.

B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.


3.3 CONSTRUCTION LAYOUT

A. Verification: Before proceeding to lay out the Work, verify layout information shown on Drawings, in relation to the property survey and existing benchmarks. If discrepancies are discovered, notify Architect promptly.

B. Site Improvements: Locate and lay out site improvements, including pavements, grading, fill and topsoil placement, utility slopes, and invert elevations.

3.4 INSTALLATION

A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.

1. Make vertical work plumb and make horizontal work level.
2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.

B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.

D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.

E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.

F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.

G. Anchors and Fasteners: Provide anchors and fasteners as required to anchor each component securely in place, accurately located and aligned with other portions of the Work.
   1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Architect.
   2. Allow for building movement, including thermal expansion and contraction.
   3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.

I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 PROGRESS CLEANING

A. General: Clean Project site and work areas daily, including common areas. Coordinate progress cleaning for joint-use areas where more than one installer has worked. Enforce requirements strictly. Dispose of materials lawfully.
   2. Do not hold materials more than 7 days during normal weather or 3 days if the temperature is expected to rise above 80 deg F.
   3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.

B. Site: Maintain Project site free of waste materials and debris.

C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
   1. Remove liquid spills promptly.
   2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.

D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.

E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.

F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.
G. Waste Disposal: Burying or burning waste materials on-site will not be permitted. Washing waste materials down sewers or into waterways will not be permitted.

H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.

I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 STARTING AND ADJUSTING

A. Start equipment and operating components to confirm proper operation. Remove malfunctioning units, replace with new units, and retest.

B. Adjust operating components for proper operation without binding. Adjust equipment for proper operation.

C. Test each piece of equipment to verify proper operation. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Manufacturer's Field Service: If a factory-authorized service representative is required to inspect field-assembled components and equipment installation, comply with qualification requirements in Division 01 Section "Quality Requirements."

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.

B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.8 CORRECTION OF THE WORK

A. Repair or remove and replace defective construction. Restore damaged substrates and finishes. Comply with requirements in Division 01 Section "Cutting and Patching."

1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.

B. Restore permanent facilities used during construction to their specified condition.

C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.

D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

E. Remove and replace chipped, scratched, and broken glass or reflective surfaces.

END OF SECTION 01 7300
SECTION 01 7329 - CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes procedural requirements for cutting and patching.

B. See Divisions 03 through 26 Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1.2 SUBMITTALS

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.

2. Changes to In-Place Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building’s appearance and other significant visual elements.

3. Products: List products to be used and firms or entities that will perform the Work.

4. Dates: Indicate when cutting and patching will be performed.

5. Utility Services and Mechanical/Electrical Systems: List services/systems that cutting and patching procedures will disturb or affect. List services/systems that will be relocated and those that will be temporarily out of service. Indicate how long services/systems will be disrupted.

6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.

7. Architect’s Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.3 QUALITY ASSURANCE

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

1. Operational Elements: Do not cut and patch operating elements and related components in a manner that results in reducing their capacity to perform as intended or that results in increased maintenance or decreased operational life or safety.

B. Miscellaneous Elements: Do not cut and patch miscellaneous elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that results in increased maintenance or decreased operational life or safety.

C. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Architect’s opinion, reduce the building’s aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.
1.4 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during cutting and patching operations, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Comply with requirements specified in other Sections.

B. In-Place Materials: Use materials identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
   1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.
   1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with in-place finishes or primers.
   2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Utility Services and Mechanical/Electrical Systems: Where existing services/systems are required to be removed, relocated, or abandoned, bypass such services/systems before cutting to prevent interruption to occupied areas.

3.3 PERFORMANCE

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.
   1. Cut in-place construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.
B. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.

2. Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. Concrete: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.

4. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.

5. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.

2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove in-place floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

4. Ceilings: Patch, repair, or rehang in-place ceilings as necessary to provide an even-plane surface of uniform appearance.

5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.

D. Cleaning: Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar materials.

END OF SECTION 01 7329
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for the following:

1. Salvaging nonhazardous construction waste.
2. Recycling nonhazardous construction waste.
3. Disposing of nonhazardous construction waste.

1.2 DEFINITIONS

A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.

B. Disposal: Removal off-site of construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.

C. Recycle: Recovery of construction waste for subsequent processing in preparation for reuse.

D. Salvage: Recovery of construction waste and subsequent sale or reuse in another facility.

E. Salvage and Reuse: Recovery of construction waste and subsequent incorporation into the Work.

1.3 PERFORMANCE GOALS

A. General: Develop waste management plan that results in end-of-Project rates for salvage/recycling to the greatest extent possible. Owner’s goal is to salvage and recycle as much nonhazardous construction waste as possible, including, but not limited to, the following materials:

1. Glass, aluminum cans, plastic bottles, pallets, wood, paper, cardboard, gypsum, steel, aluminum, roofing, insulation, carpet and pad, packaging.

B. Reduce: The Project shall generate the least amount of waste and methods shall be used that minimize waste due to error, poor planning, breakage, mishandling, contamination, or similar factors. Promote the resourceful use of materials to the greatest extent possible.

C. Reuse: The Contractor and Subcontractors shall reuse materials to the greatest extent possible. Reuse includes the following:

1. Return reusable items (e.g. pallets or unused products) to the material suppliers.

D. Recycle: As many of the waste materials as possible that are not able to be eliminated in the first place or reused, shall be recycled. Waste disposal in landfills shall be minimized to the greatest extent possible.
1.4 SUBMITTALS

A. Recycling and Processing Facility Records: Indicate receipt and acceptance of recyclable waste by recycling and processing facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

B. Landfill and Incinerator Disposal Records: Indicate receipt and acceptance of waste by landfills and incinerator facilities licensed to accept them. Include manifests, weight tickets, receipts, and invoices.

1.5 WASTE MANAGEMENT PLAN

A. General: Develop plan consisting of waste identification and waste reduction work. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.

B. Waste Identification: Indicate anticipated types and quantities of site-clearing and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.

C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, reused, or disposed of in landfill or incinerator.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

A. General: Implement waste management plan as approved by Architect. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.

3.2 RECYCLING CONSTRUCTION WASTE, GENERAL

A. General: Recycle paper and beverage containers used by on-site workers.

B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall be shared equally by Owner and General Contractor.

C. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.

1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.

a. Inspect containers and bins for contamination and remove contaminated materials if found.

2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.

4. Store components off the ground and protect from the weather.

5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.
3.3 RECYCLING CONSTRUCTION WASTE

A. Packaging:
   1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
   3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
   4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.

B. Wood Materials:
   1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
   2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.

C. Gypsum Board: Stack large clean pieces on wood pallets and store in a dry location.
   1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.

3.4 DISPOSAL OF WASTE

A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
   1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
   2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.

B. Burning: Do not burn waste materials.

C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 01 7419
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
   1. Inspection procedures.
   2. Warranties.
   3. Final cleaning.

B. Related Sections include the following:
   1. Divisions 03 through 26 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.2 SUBSTANTIAL COMPLETION

A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete in request.
   1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
   2. Advise Owner of pending insurance changeover requirements.
   3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.
   4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
   5. Prepare and submit Project Record Documents, operation and maintenance manuals, Final Completion construction photographs, damage or settlement surveys, property surveys, and similar final record information.
   6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
   7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
   8. Complete startup testing of systems.
   10. Terminate and remove temporary facilities from Project site, along with mockups, construction tools, and similar elements.
   11. Advise Owner of changeover in heat and other utilities.
   12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
   13. Complete final cleaning requirements, including touchup painting.
   14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.

B. Inspection: Submit a written request for inspection for Substantial Completion. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Architect will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Architect, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
2. Results of completed inspection will form the basis of requirements for Final Completion.

1.3 FINAL COMPLETION

A. Preliminary Procedures: Before requesting final inspection for determining date of Final Completion, complete the following:

1. Coordinate submission of a final Application for Payment.
2. Submit certified copy of the Owner Representative/Architect’s Substantial Completion inspection list of items to be completed or corrected (punch list), endorsed and dated by Architect. The certified copy of the list shall state that each item has been completed or otherwise resolved for acceptance.
3. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
4. Instruct Owner’s personnel in operation, adjustment, and maintenance of products, equipment, and systems.

B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Architect will either proceed with inspection or notify Contractor of unfulfilled requirements. Owner Representative will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.

1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.4 LIST OF INCOMPLETE ITEMS (PUNCH LIST)

A. Preparation: Submit three copies of list. Include name and identification of each space and area affected by construction operations for incomplete items and items needing correction including, if necessary, areas disturbed by Subcontractor that are outside the limits of construction.

1. Organize list of spaces in sequential order, starting with exterior areas first and proceeding from lowest floor to highest floor.
2. Organize items applying to each space by major element, including categories for ceiling, individual walls, floors, equipment, and building systems.
3. Include the following information at the top of each page:
   a. Project name.
   b. Date.
   c. Name of Subcontractor.
   d. Page number.

1.5 WARRANTIES

A. Submittal Time: Submit written warranties on request of Architect for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.

B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.

C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
1. Bind warranties and bonds in heavy-duty, 3-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.

D. Provide additional copies of each warranty to include in operation and maintenance manuals.

1.7 MAINTENANCE MANUALS

A. Prior to final acceptance, organize maintenance-and-operating manual information into three complete sets, each in manageable size, and bind into individual binders properly identified and indexed. Include emergency instructions, spare parts listing, copies of warranties, wiring diagrams, recommended “turn-around” cycles, inspection procedures, shop drawings, product data and similar applicable information.

B. Provide manuals as required by product specification sections.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

A. General: Provide final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.

B. Cleaning: Employ experienced workers or professional cleaners for final cleaning. Clean each surface or unit to condition expected in an average commercial building cleaning and maintenance program. Comply with manufacturer's written instructions.

1. Complete the cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:

   a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, of waste material, litter, and other foreign substances.

   b. Sweep paved areas broom clean. Remove spills, stains, and other foreign deposits.

   c. Remove tools, construction equipment, machinery, and surplus material from Project site.

   d. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances. Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

   e. Remove debris and surface dust from limited access spaces.

   f. Remove labels that are not permanent.
g. Wipe surfaces of mechanical and electrical equipment, elevator equipment, and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.

h. Clean plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.

i. Replace disposable air filters and clean permanent air filters. Clean exposed surfaces of diffusers, registers, and grills.

j. Clean light fixtures, lamps, globes, and reflectors to function with full efficiency.

k. Leave Project clean and ready for occupancy.

C. Comply with safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on Owner's property. Do not discharge volatile, harmful, or dangerous materials into drainage systems. Remove waste materials from Project site and dispose of lawfully.

3.2 REPAIR OF THE WORK

A. Complete repair and restoration operations before requesting inspection for determination of Substantial Completion.

B. Repair or remove and replace defective construction. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment. Where damaged or worn items cannot be repaired or restored, provide replacements. Remove and replace operating components that cannot be repaired. Restore damaged construction and permanent facilities used during construction to specified condition.

1. Remove and replace chipped, scratched, and broken glass, reflective surfaces, and other damaged transparent materials.

2. Touch up and otherwise repair and restore marred or exposed finishes and surfaces. Replace finishes and surfaces that that already show evidence of repair or restoration.

3. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.

C. Replace burned-out bulbs, bulbs noticeably dimmed by hours of use, and defective and noisy starters in fluorescent and mercury vapor fixtures to comply with requirements for new fixtures.

END OF SECTION 01 7700
SECTION 01 7823 - OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:

1. Operation and maintenance documentation directory.
2. Emergency manuals.
3. Operation manuals for systems, subsystems, and equipment.
4. Product maintenance manuals.
5. Systems and equipment maintenance manuals.

B. See Division 02 through 28 for specific operation and maintenance manual requirements for the Work in those sections.

1.2 CLOSEOUT SUBMITTALS

A. Manual Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. General Contractor will comment on whether content of operations and maintenance submittals are acceptable.
2. Where applicable, clarify and update reviewed manual content to correspond to revisions and field conditions.

B. Manual Submittal: Submit each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. General Contractor will return copy with comments.

1. Correct or revise each manual to comply with General Contractor’s comments. Submit copies of each corrected manual within 15 days of receipt of General Contractor’s comments and prior to commencing demonstration and training.

PART 2 - PRODUCTS

2.1 REQUIREMENTS FOR EMERGENCY, OPERATION, AND MAINTENANCE MANUALS

A. Directory: Prepare a single, comprehensive directory of emergency, operation, and maintenance data and materials, listing items and their location to facilitate ready access to desired information.

B. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

1. Title page.
2. Table of contents.
C. Title Page: Include the following information:

1. Subject matter included in manual.
2. Name and address of Project.
3. Name and address of Owner.
4. Date of submittal.
5. Name and contact information for Contractor.
6. Name and contact information for General Contractor.
7. Name and contact information for Architect.
8. Name and contact information for Commissioning Authority.
9. Names and contact information for major consultants to the Architect that designed the systems contained in the manuals.
10. Cross-reference to related systems in other operation and maintenance manuals.

D. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

E. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.

F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.

1. Binders: Heavy-duty, three-ring, vinyl-covered, loose-leaf binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch (215-by-280-mm) paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
   a. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name, and subject matter of contents. Indicate volume number for multiple-volume sets.

2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose diagnostic software storage media for computerized electronic equipment.

4. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
   a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
   b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.2 EMERGENCY MANUALS

A. Content: Organize manual into a separate section for each of the following:

1. Type of emergency.
2. Emergency instructions.
3. Emergency procedures.

B. Type of Emergency: Where applicable for each type of emergency indicated below, include instructions and procedures for each system, subsystem, piece of equipment, and component:
1. Fire.
2. Flood.
5. Power failure.
7. System, subsystem, or equipment failure.
8. Chemical release or spill.

C. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.

D. Emergency Procedures: Include the following, as applicable:

1. Instructions on stopping.
2. Shutdown instructions for each type of emergency.
3. Operating instructions for conditions outside normal operating limits.
4. Required sequences for electric or electronic systems.
5. Special operating instructions and procedures.

2.3 OPERATION MANUALS

A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:

2. Performance and design criteria if Contractor is delegated design responsibility.
3. Operating standards.
4. Operating procedures.
5. Operating logs.
6. Wiring diagrams.
7. Control diagrams.
8. Piped system diagrams.
9. Precautions against improper use.
10. License requirements including inspection and renewal dates.

B. Descriptions: Include the following:

1. Product name and model number. Use designations for products indicated on Contract Documents.
2. Manufacturer's name.
3. Equipment identification with serial number of each component.
4. Equipment function.
5. Operating characteristics.
6. Limiting conditions.
7. Performance curves.
8. Engineering data and tests.
9. Complete nomenclature and number of replacement parts.

C. Operating Procedures: Include the following, as applicable:

1. Startup procedures.
2. Equipment or system break-in procedures.
3. Routine and normal operating instructions.
4. Regulation and control procedures.
5. Instructions on stopping.
7. Seasonal and weekend operating instructions.
8. Required sequences for electric or electronic systems.
9. Special operating instructions and procedures.

D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.

E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.

2.4 PRODUCT MAINTENANCE MANUALS

A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.

B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Product Information: Include the following, as applicable:
   1. Product name and model number.
   2. Manufacturer's name.
   3. Color, pattern, and texture.
   5. Reordering information for specially manufactured products.

D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
   1. Inspection procedures.
   2. Types of cleaning agents to be used and methods of cleaning.
   3. List of cleaning agents and methods of cleaning detrimental to product.
   4. Schedule for routine cleaning and maintenance.
   5. Repair instructions.

E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.

F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE MANUALS

A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.

B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number
of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual.

C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
   1. Standard maintenance instructions and bulletins.
   2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
   3. Identification and nomenclature of parts and components.
   4. List of items recommended to be stocked as spare parts.

D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
   1. Test and inspection instructions.
   2. Troubleshooting guide.
   3. Precautions against improper maintenance.
   4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   5. Aligning, adjusting, and checking instructions.
   6. Demonstration and training video recording, if available.

E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.

F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.

G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.

H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

A. Emergency Manual: Assemble a complete set of emergency information indicating procedures for use by emergency personnel and by Owner's operating personnel for types of emergencies indicated.

B. Product Maintenance Manual: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.

C. Operation and Maintenance Manuals: Assemble a complete set of operation and maintenance data indicating operation and maintenance of each system, subsystem, and piece of equipment not part of a system.

D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in record Drawings to ensure correct illustration of completed installation.

1. Do not use original project record documents as part of operation and maintenance manuals.

F. Comply with Division 01 Section “Closeout Procedures” for schedule for submitting operation and maintenance documentation.

END OF SECTION 01 7823
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:

1. Demonstration of operation of systems, subsystems, and equipment.
2. Training in operation and maintenance of systems, subsystems, and equipment.
3. Demonstration and training video recordings.

B. See Divisions 02 through 26 Sections for specific requirements for demonstration and training for products in those Sections.

1.2 SUBMITTALS

A. Instruction Program: Submit three (3) copies of outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.

1. Indicate proposed training modules using manufacturer-produced demonstration and training video recordings for systems, equipment, and products in lieu of video recording of live instructional module.

B. Demonstration and Training Video Recordings: Submit three (3) copies within seven (7) days of end of each training module.

1. At completion of training, submit complete training manual(s) for Owner's use prepared and bound in format matching operation and maintenance manuals.

1.3 QUALITY ASSURANCE

A. Facilitator Qualifications: A firm or individual experienced in training or educating maintenance personnel in a training program similar in content and extent to that indicated for this Project, and whose work has resulted in training or education with a record of successful learning performance.

B. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 1 Section "Quality Requirements," experienced in operation and maintenance procedures and training.

C. Preinstruction Conference: Conduct conference at Project site. Review methods and procedures related to demonstration and training.

1.4 COORDINATION

A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations and to ensure availability of Owner's personnel.
B. Coordinate content of training modules with content of approved emergency, operation, and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Architect.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

A. Program Structure: Develop an instruction program that includes individual training modules for each system and equipment not part of a system, as required by individual Specification Sections.

B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following, as applicable to the system, equipment, or component:

1. Basis of System Design, Operational Requirements, and Criteria:
   a. System, subsystem, and equipment descriptions.
   b. Performance and design criteria if Contractor is delegated design responsibility.
   c. Operating standards.
   d. Regulatory requirements.
   e. Equipment function.
   f. Operating characteristics.
   g. Limiting conditions.
   h. Performance curves.

2. Documentation: Review the following items in detail:
   a. Emergency manuals.
   b. Operations manuals.
   c. Maintenance manuals.
   d. Project record documents.
   e. Identification systems.
   f. Warranties and bonds.
   g. Maintenance service agreements and similar continuing commitments.

3. Emergencies: Include the following, as applicable:
   a. Instructions on meaning of warnings, trouble indications, and error messages.
   b. Instructions on stopping.
   c. Shutdown instructions for each type of emergency.
   d. Operating instructions for conditions outside of normal operating limits.
   e. Sequences for electric or electronic systems.
   f. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
   a. Startup procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Instructions on stopping.
   h. Normal shutdown instructions.
   i. Operating procedures for emergencies.
   j. Operating procedures for system, subsystem, or equipment failure.
   k. Seasonal and weekend operating instructions.
   l. Required sequences for electric or electronic systems.
m. Special operating instructions and procedures.

5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.

6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.

7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning.
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.

8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Section 01 7823 “Operation and Maintenance Data.”

3.2 INSTRUCTION

A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, instruction times, and location.

B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.

   1. Owner will furnish an instructor to describe Owner's operational philosophy.

C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season.

   1. Schedule training with Owner, with at least seven (7) days advance notice.

D. Training Location and Reference Material: Conduct training on-site in the completed and fully operational facility using the actual equipment in-place. Conduct training using final operation and maintenance data submittals.

E. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of a demonstration performance-based test.
3.3 DEMONSTRATION AND TRAINING VIDEO RECORDINGS

A. General: Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.

   1. At beginning of each training module, record each chart containing learning objective and lesson outline.

B. Video Recording Format: Provide high-quality color video recordings with menu navigation in format acceptable to Architect.

C. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

D. Preproduced Video Recordings: Provide video recordings used as a component of training modules in same format as recordings of live training.

END OF SECTION 01 7900
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following, as indicated on the Drawings:

1. Demolition and removal of selected portions of building and building structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

B. Related Sections include the following:

1. Division 01, Section “Construction Waste Management & Disposal” for recycling and disposal of construction waste.
2. Division 01 Section “Cutting and Patching.”
3. Division 03, Section “Cast-in-Place Concrete” for new concrete foundation walls and stoop.
4. Divisions 22, 23 and 26 for requirements for removing plumbing, HVAC and electrical components and systems.

C. Unless otherwise indicated herein, selective demolition will be provided by the Contractor.

1.2 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site, unless indicated to be removed and salvaged or removed and reinstalled.

B. Remove and Salvage: Detach items from existing construction and deliver them to Owner ready for reuse.

C. Remove and Reinstall: Detach items from existing construction, prepare them for reuse, and reinstall them where indicated.

D. 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.

1.3 SUBMITTALS

A. Schedule of Selective Demolition Activities: Indicate detailed sequence of selective demolition and removal work, with starting and ending dates for each activity, interruption of utility services, use of elevator and stairs, and locations of temporary partitions and means of egress.

B. Pre-demolition Photographs or Videotapes: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by selective demolition operations.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with governing EPA notification regulations before beginning selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.
1. Maintain Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes. Records to be submitted to Owner if requested.

B. Standards: Comply with ANSI A10.6 and NFPA 241.

C. Pre-demolition Conference: Conduct conference at Project site.

1.5 PROJECT CONDITIONS

A. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

B. If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify Owner. Owner will remove hazardous materials under a separate contract.

C. Storage or sale of removed items or materials on-site is not permitted.

D. Conduct demolition activities so occupancy of the building will not be disrupted. Provide Owner with not less than 48 hours notice of activities that may affect the department’s operations.

E. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Maintain fire-protection facilities in service during selective demolition operations.

1.6 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that utilities as required have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated mechanical, electrical, or structural elements that conflict with intended function or design are encountered, investigate and measure the nature and extent of conflict. Promptly submit a written report to Architect.

E. Survey of Existing Conditions: Record existing conditions by use of measured drawings, preconstruction photographs, preconstruction videotapes and templates.

F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.
3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems: Maintain services/systems indicated to remain and protect them against damage during selective demolition operations.

B. Service/System Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. Arrange to shut off indicated utilities with utility companies.
   2. If services/systems are required to be removed, relocated, or abandoned, before proceeding with selective demolition provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   3. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit after bypassing.

3.3 PREPARATION

A. Site Access and Temporary Controls: Conduct selective demolition and debris-removal operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.

B. Temporary Facilities: Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities to remain.

C. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.

3.4 SELECTIVE DEMOLITION

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.
   2. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
   3. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain fire watch and portable fire-suppression devices during flame-cutting operations.
   4. Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
   5. Dispose of demolished items and materials promptly.

B. Removed and Salvaged Items:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner’s storage area designated by Owner.
   5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:
1. Clean and repair items to functional condition adequate for intended reuse. Paint equipment to match new equipment.
2. Pack or crate items after cleaning and repairing. Identify contents of containers.
3. Protect items from damage during transport and storage.
4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

D. Existing Items to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by Architect, items may be removed to a suitable, protected storage location during selective demolition and cleaned and reinstalled in their original locations after selective demolition operations are complete.

3.5 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be recycled, reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Owner's property and legally dispose of them.

3.6 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION 02 4119
SECTION 03 3000 – CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 SUMMARY

   A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

1.2 DEFINITIONS

   A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

   B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS

   A. Product Data: For each type of product.

   B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

      1. Indicate amounts of mixing water to be withheld for later addition at Project site.

   C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.

   D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

      1. Location of construction joints is subject to approval of the Architect.

1.4 INFORMATIONAL SUBMITTALS

   A. Qualification Data: For testing agency.

   B. Material Certificates: For each of the following, signed by manufacturers:

      1. Cementitious materials.
      2. Admixtures.
      3. Steel reinforcement and accessories.
      4. Fiber reinforcement.
      5. Curing compounds.
      6. Vapor retarders.

   C. Material Test Reports: For the following, from a qualified testing agency:
1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

D. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.

E. Field quality-control reports.

F. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.

1.7 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.

1. When average high and low temperature is expected to fall below 40 deg F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
   1. ACI 301.
   2. ACI 117.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
   1. Plywood, metal, or other approved panel materials.
   2. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
      a. For standard finish, use Structural 1, B-B or better; mill oiled and edge sealed.
      OR
      b. B-B (Concrete Form), Class 1 or better; mill oiled and edge sealed.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.


D. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.

E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

F. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
   1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

B. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

C. Epoxy-Coated Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed bars, ASTM A 775/A 775M, epoxy coated, with less than 2 percent damaged coating in each 12-inch bar length.

2.4 REINFORCEMENT ACCESSORIES

A. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A 775/A 775M.
B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

1. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

2.5 CONCRETE MATERIALS

A. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C 150/C 150M, Type I/II.
2. Fly Ash: ASTM C 618, Class F or C.
3. Slag Cement: ASTM C 989/C 989M, Grade 100 or 120.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, coarse aggregate meeting limits for deleterious substances as indicated in ASTM C33 for the weathering region the project is located in, for the element being constructed or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years’ satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 3/4 inches, but not more than 1/3 the slab thickness, nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

F. Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions in concrete and complying with ASTM C 494/C 494M, Type C.

G. Non-Set-Accelerating Corrosion-Inhibiting Admixture: Commercially formulated, non-set-accelerating, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.

2.6 FIBER REINFORCEMENT

A. Synthetic Macro-Fiber: Polyolefin or polypropylene macro-fibers engineered and designed for use in concrete, complying with ASTM C 1116/C 1116M, Type III, 2-1/4 inches long.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. BASF Corp. - Construction Chemicals.
   b. Euclid Chemical Company (The); an RPM company.
   c. FORTA Corporation.
   d. GCP Applied Technologies Inc. (formerly Grace Construction Products).
   e. Nycon, Inc.
   f. Propex Operating Company, LLC.

2.7 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A.

2.8 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.9 RELATED MATERIALS


B. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
   1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

D. Reglets: Fabricate reglets of not less than 0.022-inch-thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

2.10 REPAIR MATERIALS

A. Repair Underlayment for slabs beneath floor coverings: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C 109/C 109M.

B. Repair Overlayment for slabs with no floor covering: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C 109/C 109M.

2.11 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.

B. Cementitious Materials: For concrete not exposed to deicing salts, use fly ash, pozzolan, slag cement, and silica fume as needed to reduce the total amount of portland cement, which would otherwise be used, by not less than 35 percent.

For concrete exposed to deicing salts, limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 25 percent.
4. Combined Fly Ash or Pozzolan and Slag Cement: 50 percent portland cement minimum, with fly ash or pozzolan not exceeding 25 percent.
5. Silica Fume: 10 percent.
6. Combined Fly Ash, Pozzolans, and Silica Fume: 35 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.
7. Combined Fly Ash or Pozzolans, Slag Cement, and Silica Fume: 50 percent with fly ash or pozzolans not exceeding 25 percent and silica fume not exceeding 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to

1. 0.06 percent by weight of cement for prestressed concrete.
2. 0.15 percent by weight of cement for reinforced concrete exposed to chlorides.
3. 0.30 percent by weight of cement for reinforced concrete not protected from moisture.
4. 1.00 percent by weight of cement for reinforced concrete protected from moisture.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal-weight concrete.
   1. Minimum Compressive Strength: As indicated at 28 days.
   2. Maximum W/C Ratio: 0.50.
   3. Slump Limit: 6 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
   4. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for ¾ inch to 1-inch nominal maximum aggregate size.

   1. Minimum Compressive Strength: As indicated at 28 days.
   2. Maximum W/C Ratio: 0.50.
   3. Slump Limit: 6 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
   4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size.
   5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch or 3/4-inch nominal maximum aggregate size.

C. Slabs-on-Grade and Topping Slabs: Normal-weight concrete.
   1. Minimum Compressive Strength: As indicated at 28 days.
   2. Maximum W/C Ratio: 0.43.
   4. As an alternate to limit of 27 gal/cu yd, water content, provide documentation of the shrinkage tests the proposed concrete mix conducted in accordance with ASTM C157 for specimens cured for 7 days in water and placed in drying environment for 21 days confirming length change to be less than 0.04% at 28 days.
   5. Adjust the proportions of combined coarse, intermediate, and fine aggregates to provide the following particle size distribution, unless otherwise approved:
      a. Coarseness Factor (CF) of 60 to 70%
      b. Adjusted workability factor of [(11.25 – 0.15 CF) + 36] +/- 2.5
      c. Combined percent retained on any one sieve shall not exceed 22%
      d. Maximum fine aggregate (sand) content 8.5 cu ft per cubic yard.
   6. Slump Limit: 6 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
   7. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch nominal maximum aggregate size; 6 percent, plus or minus 1.5 percent at point of delivery for 3/4-inch to 1-inch nominal maximum aggregate size. Do not allow air content of trowel-finished floors to exceed 3 percent.
   8. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at rate indicated on drawings.

2.13 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."
2.14 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

2. Class B, 1/4 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.

1. Install keyways, reglets, recesses, and the like, for easy removal.
2. Do not use rust-stained steel form-facing material.

F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.

G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.

H. Chamfer exterior corners and edges of permanently exposed concrete.

I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
3.2 EMBEDDED ITEM INSTALLATION

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.

3.3 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.

3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

F. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D 3963/D 3963M. Use epoxy-coated steel wire ties to fasten epoxy-coated steel reinforcement.

3.5 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.

1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.

2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.

3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of contraction joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.

D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Section 07 9200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.
E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.7 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.

C. Rubbed Finish: Apply the following to smooth-formed-finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.
2. Grout-Cleaned Finish: Wet concrete surfaces and apply grout of a consistency of thick paint to coat surfaces and fill small holes. Mix 1 part portland cement to 1-1/2 parts fine sand with a 1:1 mixture of bonding admixture and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Scrub grout into voids and remove excess grout. When grout whitens, rub surface with clean burlap and keep surface damp by fog spray for at least 36 hours.
3. Cork-Floated Finish: Wet concrete surfaces and apply a stiff grout. Mix 1 part portland cement and 1 part fine sand with a 1:1 mixture of bonding agent and water. Add white portland cement in amounts determined by trial patches, so color of dry grout matches adjacent surfaces. Compress grout into voids by grinding surface. In a swirling motion, finish surface with a cork float.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.8 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbled. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.
1. Apply scratch finish to surfaces indicated and to receive concrete floor toppings, to receive mortar setting beds, and for bonded cementitious floor finishes.

C. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces indicated to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated, exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:
   a. Specified overall values of flatness, \( F(F) \) 35; and of levelness, \( F(L) \) 25; with minimum local values of flatness, \( F(F) \) 24; and of levelness, \( F(L) \) 17; for slabs-on-grade.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated, and where ceramic or quarry tile is to be installed by either thickest or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.9 MISCELLANEOUS CONCRETE ITEM INSTALLATION

A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.

2. Construct concrete bases 4 inches high unless otherwise indicated, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.

3. Minimum Compressive Strength: 4000 psi at 28 days.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.

5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.

6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.
3.10 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305.1 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer’s written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for remainder of curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
   a. Water.
   b. Continuous water-fog spray.
   c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer’s written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
   a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound does not interfere with bonding of floor covering used on Project.

3.11 LIQUID FLOOR TREATMENT APPLICATION

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer’s written instructions.

1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
2. Do not apply to concrete that is less than seven days’ old.
3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer's written instructions.

3.12 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month. Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

3.13 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.

3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.

2. After concrete has cured at least 14 days, correct high areas by grinding.

3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.

5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.14 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

B. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
   a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
3. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
4. Air Content: ASTM C 231/C 231M, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

Compression Test Specimens: ASTM C 31/C 31M.

a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.

a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

Strength of each concrete mixture will be satisfactory if every average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

Test results shall be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following:
   1. Architectural precast sills, trim, coping and caps.
   2. Architectural precast lintels to support weight of masonry veneer above openings.

1.2 DEFINITION
A. Design Reference Sample: Sample of approved architectural precast concrete color, finish and texture, preapproved by Architect.

1.3 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Design Mixtures: For each precast concrete mixture. Include compressive strength and water-absorption tests.
C. Shop Drawings: Detail fabrication and installation of architectural precast concrete units. Indicate locations, plans, elevations, dimensions, shapes, and cross sections of each unit. Indicate joints, reveals, and extent and location of each surface finish. Indicate details at building corners.
D. Samples: For each type of finish indicated on exposed surfaces of architectural precast concrete units, in sets of 3, illustrating full range of finish, color, and texture variations expected; approximately 12 by 12 by 2 inches.

1.4 QUALITY ASSURANCE
A. Fabricator Qualifications: PCI plant certification was established in 1967 and is a different program than APA's plant certification established in 1993. Consult APA or PCI for further information.
   1. Participates in PCI's plant certification program and is designated a PCI-certified plant for Group A, Category A1 - Architectural Cladding and Load Bearing Units or participates in APA's "Plant Certification Program for Production of Architectural Precast Concrete Products" and is designated an APA-certified plant.
   2. Fabricator shall provide Professional Engineer's certification that approves lintels for load carrying capacity required by project.
B. Design Standards: Comply with ACI 318 and design recommendations of PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of architectural precast concrete units indicated.
C. Quality-Control Standard: For manufacturing procedures and testing requirements, quality-control recommendations, and dimensional tolerances for types of units required, comply with PCI MNL 117, "Manual for Quality Control for Plants and Production of Architectural Precast Concrete Products."
PART 2 - PRODUCTS

2.1 REINFORCING MATERIALS

A. Recycled Content of Steel Products: Provide products with an average recycled content of steel products so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 60 percent.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade, deformed.

C. Low-Alloy-Steel Reinforcing Bars: ASTM A 706/A 706M, deformed.

D. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.


F. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 117.

2.2 CONCRETE MATERIALS

A. Portland Cement: ASTM C 150, Type I or Type III, gray, unless otherwise indicated.

1. For surfaces exposed to view in finished structure, mix gray with white cement, of same type, brand, and mill source.

B. Supplementary Cementitious Materials:

1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3 percent.
2. Metakaolin Admixture: ASTM C 618, Class N.
4. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 100 or 120.

C. Normal-Weight Aggregates: Except as modified by PCI MNL 117, ASTM C 33, with coarse aggregates complying with Class 5S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.

1. Face-Mixture-Coarse Aggregates: Selected, hard, and durable; free of material that reacts with cement or causes staining; to match selected finish sample.

2. Face-Mixture-Fine Aggregates: Selected, natural or manufactured sand of same material as coarse aggregate, unless otherwise approved by Architect.

D. Coloring Admixture: ASTM C 979, synthetic or natural mineral-oxide pigments or colored water-reducing admixtures, temperature stable, and nonfading.

1. Colors to match precast concrete in Stage 1.

E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride or more than 0.15 percent chloride ions or other salts by weight of admixture.
2.3 STEEL CONNECTION MATERIALS

A. Carbon-Steel Shapes and Plates: ASTM A 36/A 36M.
B. Carbon-Steel Headed Studs: ASTM A 108, AISI 1018 through AISI 1020, cold finished, AWS D1.1/D1.1M, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 117, Table 3.2.3.
C. Carbon-Steel Plate: ASTM A 283/A 283M.
D. Malleable Iron Castings: ASTM A 47/A 47M.
E. Carbon-Steel Castings: ASTM A 27/A 27M, Grade 60-30 (Grade 415-205).
F. High-Strength, Low-Alloy Structural Steel: ASTM A 572/A 572M.
G. Deformed-Steel Wire or Bar Anchors: ASTM A 496 or ASTM A 706/A 706M.
H. Carbon-Steel Bolts and Studs: ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A 563 (ASTM A 563M); and flat, unhardened steel washers, ASTM F 844.

2.4 GROUT MATERIALS

A. Sand-Cement Grout: Portland cement, ASTM C 150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

2.5 CONCRETE MIXTURES

A. Prepare design mixtures for each type of precast concrete required.
   1. Limit use of fly ash and silica fume to 20 percent of Portland cement by weight; limit metakaolin and silica fume to 10 percent of Portland cement by weight.
B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at architectural precast concrete fabricator's option.
C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 117 when tested according to ASTM C 1218/C 1218M.
D. Normal-Weight Concrete Mixtures: Proportion mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
E. Water Absorption: 6 percent by weight or 14 percent by volume, tested according to PCI MNL 117.
F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 117.
G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
2.6 FABRICATION

A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.

1. Weld headed studs and deformed bar anchors used for anchorage according to AWS D1.1/D1.1M and AWS C5.4, "Recommended Practices for Stud Welding."

B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing architectural precast concrete units to supporting and adjacent construction.

C. Cast-in reglets, slots, holes, and other accessories in architectural precast concrete units as indicated on the Contract Drawings.

D. Reinforcement: Comply with recommendations in PCI MNL 117 for fabricating, placing, and supporting reinforcement.

E. Reinforce architectural precast concrete units to resist handling, transportation, and erection stresses.

F. Comply with requirements in PCI MNL 117 and requirements in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.

G. Place concrete in a continuous operation to prevent seams or planes of weakness from forming in precast concrete units.

1. Place backup concrete mixture to ensure bond with face-mixture concrete.

H. Thoroughly consolidate placed concrete by internal and external vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air on surfaces. Use equipment and procedures complying with PCI MNL 117.

1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

I. Comply with PCI MNL 117 for hot- and cold-weather concrete placement.

J. Identify pickup points of architectural precast concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each architectural precast concrete unit on a surface that will not show in finished structure.

K. Cure concrete, according to requirements in PCI MNL 117, by moisture retention without heat or by accelerated heat curing using low-pressure live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.

L. Discard and replace architectural precast concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 117 and Architect's approval.
2.7 FABRICATION TOLERANCES

A. Fabricate architectural precast concrete units straight and true to size and shape with exposed edges and corners precise and true so each finished panel complies with PCI MNL 117 product tolerances as well as position tolerances for cast-in items.

2.8 FINISHES

A. Panel faces shall be free of joint marks, grain, and other obvious defects. Corners, including false joints shall be uniform, straight, and sharp. Finish exposed-face surfaces of architectural precast concrete units to match approved design reference sample and as follows:
   1. Honed Finish: Use continuous mechanical abrasion with fine grit, followed by filling and rubbing procedures.

B. Finish exposed top bottom and back surfaces of architectural precast concrete units to match face-surface finish.

C. Finish unexposed surfaces of architectural precast concrete units by float finish.

2.9 SOURCE QUALITY CONTROL

A. Quality-Control Testing: Test and inspect precast concrete according to PCI MNL 117 requirements. If using self-consolidating concrete, also test and inspect according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete Institute Member Plants."

B. Owner will employ an independent testing agency to evaluate architectural precast concrete fabricator's quality-control and testing methods.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install clips, hangers, bearing pads, and other accessories required for connecting architectural precast concrete units to supporting members and backup materials.

B. Erect architectural precast concrete level, plumb, and square within specified allowable tolerances. Provide temporary supports and bracing as required to maintain position, stability, and alignment as units are being permanently connected.

   1. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
   2. Unless otherwise indicated, provide for uniform joint widths of 3/4 inch (19 mm).

C. Connect architectural precast concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.

D. Welding: Comply with applicable AWS D1.1/D1.1M and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.

E. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
F. Grouting Connections: Grout connections where required or indicated. Retain grout in place until hard enough to support itself. Pack spaces with stiff grout material, tamping until voids are completely filled. Place grout to finish smooth, level, and plumb with adjacent concrete surfaces. Keep grouted joints damp for not less than 24 hours after initial set. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.

G. Erect architectural precast concrete units level, plumb, square, true, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 117, Appendix I.

3.2 REPAIRS

A. Repair damaged architectural precast concrete units if permitted by Architect. The Architect reserves the right to reject repaired units that do not comply with requirements.

B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet (6 m).

C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A 780.

D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.

E. Remove and replace damaged architectural precast concrete units when repairs do not comply with requirements.

3.3 CLEANING

A. Clean surfaces of precast concrete units exposed to view.

B. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.

C. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.

1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's recommendations. Clean soiled precast concrete surfaces with detergent and water, using stiff fiber brushes and sponges, and rinse with clean water. Protect other work from staining or damage due to cleaning operations.

2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Manufactured stone veneer.
2. Manufactured stone trim.
3. Manufactured stone sills and bands.

1.2 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including installation instructions and dimensions of individual components.

B. Samples: For each color, grade, finish, texture, and variety of stone required; 12 inch x 12 inch minimum.

C. Mock-Ups:
   1. Build mock-ups for each type of stone veneer assembly in sizes approximately 48 inches long by 48 inches high by full thickness, including face and backup.
   2. Protect accepted mock-ups from the elements with weather-resistant membrane.
   3. Approval of mock-ups is for color, texture, and blending of stone; relationship of mortar and sealant colors to stone colors; tooling of joints; and aesthetic qualities of workmanship.
   4. Do not begin installation of stone veneer work until the Architect accepts the mock-ups. Remove unacceptable mock-ups from the site.
   5. Approved mock-ups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Colored Mortar Samples: For each mortar color required.

E. Qualification Data: For manufacturer with minimum of five years in producing manufactured masonry. For installer with minimum of five years experience installing manufactured masonry.

F. Material Test Reports.

1.3 REFERENCES

A. American Concrete Institute (ACI).

B. Applicable ASTM standards.
1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer of manufactured stone units similar to those indicated for this Project, with sufficient production capacity to manufacture required units, and with a history of successful installations on projects of similar size and scope.

B. Installer Qualifications: Company with documented experience in installation of manufactured masonry, including a minimum of five (5) projects within a 400 mile radius of this Project.

C. Source Limitations for Stone: Obtain each variety of stone, regardless of finish, from a single quarry with resources to provide materials of consistent quality in appearance and physical properties.
   1. Obtain each variety of stone from a single quarry, whether specified in this Section or in another Section of the Specifications.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store products off the ground on pallets in manufacturer's unopened packaging until ready for installation.

B. Follow manufacturer’s instructions.

C. Store moisture-sensitive materials in weather protected enclosures.

1.6 PROJECT/SITE CONDITIONS

A. Environmental Requirements: Maintain materials and ambient temperature in area of installation at minimum 40 degree F prior to, during, and for 48 hours following installation.

B. Protection of Stone Veneer Assemblies: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day’s work. Cover partially completed stone veneer assemblies when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.

C. Stain Prevention: Immediately remove mortar and soil to prevent them from staining the face of stone veneer assemblies.
   1. Protect base of walls from rain-splashed mud and mortar splatter by coverings spread on the ground and over the wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at end of each day to prevent rain from splashing mortar and dirt on completed stone veneer assemblies.

D. Cold Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace stone veneer assemblies damaged by frost or freezing conditions. Comply with cold weather-construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1.7  WARRANTY
   A. Special Warranty: Provide manufacturer’s standard limited warranty against defects in manufacturing for a period of 50 years following date of Substantial Completion.

1.8  MAINTENANCE
   A. Extra Maintenance: Furnish extra manufactured stone material in a variety of shapes and sizes in quantity equal to three (3) % of the installed stone.

PART 2 - PRODUCTS

2.1  MANUFACTURERS
   A. Basis-of-Design Manufacturer: Dutch Quality Stone.
      1. Or Approved Equal.

2.2  MANUFACTURED UNITS
   A. Provide manufactured masonry units as shown on Drawings.
   B. Colors and Textures: Weather Ledge (Natural Blend).

2.3  ACCESSORIES
   A. Weather Resistant Barrier: No. 15, Type 1, asphalt saturated felt, ASTM D 226.
   B. Metal Lath: 18 gauge galvanized woven wire mesh or galvanized 2.5 lb diamond pattern mesh.
   C. Metal Flashing: 24 gauge galvanized steel; ASTM A 653.
   D. Fasteners Into Wood Studs: Minimum 0.120 inch shank diameter galvanized nails or staples of sufficient length to penetrate 1-3/8 inches minimum into the stud.

2.4  MORTAR
   A. Portland Cement, ASTM C150, Type I or masonry cement (Type N), ASTM C91.
   B. Masonry sand.
   C. Lime: ASTM C207.
   D. Iron oxide pigments; ASTM C979.
2.5 MORTAR MIXES

A. Mixing: Mix proprietary materials in accordance with manufacturer's instructions, including product data and product technical bulletins. Thoroughly mix mortar ingredients in quantities needed for immediate use in accordance with ASTM C270, Type N. Do not use antifreeze compounds to lower the freezing point of mortar.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates upon which manufactured masonry will be installed. Do not begin installation until substrates have been properly prepared.

B. Coordinate with responsible trades to correct unsatisfactory conditions.

C. Commencement of work by installer is acceptance of substrate conditions.

3.2 PREPARATION

A. Protection: Prevent work from occurring on opposite walls to which manufactured masonry is applied during and for 48 hours following installation of the manufactured masonry.

B. Clean surfaces thoroughly prior to installation.

C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install products and materials in accordance with manufacturer’s installation instructions.

B. Keep surfaces moist while installing.

C. Cover application surface completely with 1/2 to 3/4-inch-thick application of scratch coat. Lightly rake horizontal grooves in the scratch coat. Allow scratch coat to set up/cure, but do not let scratch coat dry before applying manufactured stone.

D. Make certain surface of stone and wall is free of dirt, sand, or loose particles.

E. Determine if stones will be laid out on ground to the desired fit prior to installation, or if trimming is required to complete finished application.

F. Sort stone before it is placed in wall to remove stone that does not comply with requirements relating to aesthetic effects, physical properties, or fabrication, or that is otherwise unsuitable for intended use.

G. Cutting: Perform necessary cutting with proper tools to provide uniform edges; take care to prevent breaking unit corners of edges.

H. Setting Units: Press each stone into the mortar setting bed firmly enough to squeeze some mortar out around the stone's edges. Apply pressure to the stone to ensure a good bond. Ensure complete coverage between the mortar bed and back surface of the stone; mortar may also be applied to the entire back of the stone.
I. Maintain uniform joint widths except for variations due to different stone sizes and where minor variations are required to maintain bond alignment, if any. Lay walls with joints not less than 1/4 inch at narrowest points nor more than 5/8 inch at widest points.

J. Use grout bag or trowel to fill all joints. As mortar stiffens, tool to the desired depth and be sure to brush off all excess.

K. Remove excess mortar. Any mortar forced out beyond the finished joint or on the stone surface must be removed with trowel, joint tool, or brush before the mortar is allowed to set up. Do not allow mortar to set up on face of units. Clean and finish joints in accordance with manufacturer’s instructions.

L. Poorly attached stones are considered defective work. After set-up, inspect wall for loose stones. Remove and properly replace.

3.4 CLEANING

A. Cleaning: Remove temporary coverings and protection of adjacent work areas. Remove construction debris from project site and legal dispose of debris.
   1. Cleaning: Use a strong solution of granulated soap or detergent and water with a bristle brush. Do not use a wire brush as it will damage the surface. Rinse immediately with fresh water. Do not attempt to clean using acid or acid-based products. Do not clean with high-pressure power washer.
   2. Do not use de-icing chemicals on areas immediately adjacent to a manufactured stone products application.

B. Clean manufactured stone as work progresses.
   1. Remove mortar fins and smears before tooling joints.
   2. Remove excess sealant immediately, including spills, smears, and spatter.
   3. Excess dirt and film may be removed using clean water and a stiff brush.

C. Efflorescence: To remove efflorescence, allow stone to dry thoroughly, then scrub vigorously with a stiff bristle brush and clean water. Rinse thoroughly. Do not use a wire brush. For difficult efflorescence problems, scrub thoroughly with a solution of one (1) part white household vinegar to five (5) parts water. Rinse thoroughly.

3.5 EXCESS MATERIALS AND WASTE

A. Excess Stone: Stack excess usable stone where directed by Owner for Owner’s use.

B. Disposal as Fill Material: Dispose of clean masonry waste, including mortar and excess or soil-contaminated sand, by crushing and mixing with fill material as fill is placed. Do not dispose of masonry waste as fill within 18 inches of finished grade.

3.6 PROTECTION

A. Protect finished work from rain and either side of the wall during and for 48 hours following installation.

B. Protect finished work from damage during remainder of construction period.

C. Touch-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION 04 7200
SECTION 05 1200 – STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Structural steel.
   2. Field-installed shear connectors.

B. Related Requirements:
   1. Section 05 3100 "Steel Decking" for field installation of shear connectors through deck.
   2. Section 05 5000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame, miscellaneous steel fabrications, and other steel items not defined as structural steel.
   3. Section 09 9125 "Painting" for surface-preparation and priming requirements.
   4. Section 13 3419 "Metal Building Systems" for structural design requirements, material specifications, and tolerances.

1.2 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

B. Heavy Sections: Rolled and built-up sections as follows:
   1. Shapes included in ASTM A 6/A 6M with flanges thicker than 1-1/2 inches.
   2. Welded built-up members with plates thicker than 2 inches.
   3. Column base plates thicker than 2 inches.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show fabrication of structural-steel components.
1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members and connections of the Seismic-Load-Resisting System.
6. Indicate locations and dimensions of protected zones.
7. Identify demand critical welds.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide according to AWS D1.1/D1.1M, “Structural Welding Code - Steel,” for each welded joint whether prequalified or qualified by testing, including the following:
   1. Power source (constant current or constant voltage).
   2. Electrode manufacturer and trade name, for demand critical welds.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For installer, fabricator, and testing agency.
B. Welding certificates.
C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
D. Mill test reports for structural steel, including chemical and physical properties.
E. Product Test Reports: For the following:
   1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
   2. Shear stud connectors.
   3. Shop primers.

F. Source quality-control reports.
G. Field quality-control and special inspection reports.

1.7 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172).
B. Installer Qualifications: A qualified installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category ACSE.
C. Shop-Painting Applicators: Qualified according to AISC’s Sophisticated Paint Endorsement P2 or to SSPC-QP 3, “Standard Procedure for Evaluating Qualifications of Shop Painting Applicators.”
D. **Welding Qualifications:** Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1. Welders and welding operators performing work on bottom-flange, demand-critical welds shall pass the supplemental welder qualification testing, as required by AWS D1.8/D1.8M. FCAW-S and FCAW-G shall be considered separate processes for welding personnel qualification.

E. Comply with applicable provisions of the following specifications and documents:

1. AISC 303.
2. AISC 341 and AISC 341s1.
3. AISC 360.
4. RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1.8 **DELIVERY, STORAGE, AND HANDLING**

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

**PART 2 - PRODUCTS**

2.1 **STRUCTURAL-STEEL MATERIALS**

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. Corrosion-Resisting Structural-Steel Shapes, Plates, and Bars: ASTM A 588/A 588M, Grade 50.

E. Cold-Formed Hollow Structural Sections: ASTM A 500/A 500M, Grade B, structural tubing.

F. Corrosion-Resisting, Cold-Formed Hollow Structural Sections: ASTM A 847/A 847M, structural tubing.

G. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.

1. Weight Class: Standard.
2. Finish: Black except where indicated to be galvanized.
H. Steel Castings: ASTM A 216/A 216M, Grade WCB with supplementary requirement S11.

I. Steel Forgings: ASTM A 668/A 668M.

J. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, (ASTM A 563M, Class 8S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers; all with plain finish.

B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH (ASTM A 563M, Class 10S) heavy-hex carbon-steel nuts; and ASTM F 436 (ASTM F 436M), Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.

C. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

D. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

3. Washers: ASTM F 436, Type 1, hardened carbon steel.

E. Threaded Rods: ASTM A 36/A 36M.


F. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

G. Eye Bolts and Nuts: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1030.


2.3 PRIMER

A. Primer: Aromatic urethane zinc-rich with a minimum zinc load of 83% at 2.5 – 3.5 mils dry film thickness.

B. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

C. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.
2.4 GROUT

A. Metallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, metallic aggregate grout, mixed with water to consistency suitable for application and a 30-minute working time.

B. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.5 FABRICATION


1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 2, "Hand Tool Cleaning."

F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.

G. Steel Wall-Opening Framing: Select true and straight members for fabricating steel wall-opening framing to be attached to structural-steel frame. Straighten as required to provide uniform, square, and true members in completed wall framing. Build up welded framing, weld exposed joints continuously, and grind smooth.

H. Welded Door Frames: Build up welded door frames attached to structural-steel frame. Weld exposed joints continuously and grind smooth. Plug-weld fixed steel bar stops to frames. Secure removable stops to frames with countersunk machine screws, uniformly spaced not more than 10 inches on center unless otherwise indicated.

I. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.
2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC’s "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

A. Shop prime steel surfaces except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 2, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
5. SSPC-SP 14/NACE No. 8, "Industrial Blast Cleaning."
6. SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   a. With a minimum angular profile of 1.5 mils for high-performance coating.
7. SSPC-SP 10/NACE No. 2, "Near-White Blast Cleaning."
8. SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning."
9. SSPC-SP 8, "Pickling."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer’s written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils, and not less than 2.5 mils for high-performance coating. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

D. Primer for High-Performance Coating: Aromatic urethane zinc-rich with a minimum zinc load of 83% at 2.5 – 3.5 mils dry film thickness.

E. Intermediate Coat for High-Performance Coating: Polyamide epoxy at 4.0 – 5.0 mils dry film thickness.

F. Top Coat for High Performance Coating: See Division 09, Section “Painting.”
G. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.8 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A 123/A 123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels, shelf angles, and welded door frames attached to structural-steel frame and located in exterior walls.

2.9 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform shop tests and inspections.

1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

1. Liquid Penetrant Inspection: ASTM E 165.
2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.
1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

1. Do not remove temporary shoring supporting composite deck construction until cast-in-place concrete has attained its design compressive strength.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 and AISC 360.


1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1/D1.1M and manufacturer's written instructions.
3.4 **FIELD CONNECTIONS**

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.

3.5 **FIELD QUALITY CONTROL**

A. Special Inspections: Engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test and inspect field welds according to AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:
   a. Liquid Penetrant Inspection: ASTM E 165.
   b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
   c. Ultrasonic Inspection: ASTM E 164.
   d. Radiographic Inspection: ASTM E 94.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 **REPAIRS AND PROTECTION**

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.
B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
   1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

C. Touchup Painting: Cleaning and touchup painting are specified in Section 09 9123 "Interior Painting."

END OF SECTION 05 1200
SECTION 05 3100 – STEEL DECKING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Composite floor deck.

B. Related Requirements:
   1. Section 03 3000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
   2. Section 05 1200 "Structural Steel Framing" for shop- and field-welded shear connectors.
   3. Section 05 5000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Power-actuated mechanical fasteners.

D. Evaluation Reports: For steel deck, from ICC-ES.

E. Field quality-control reports.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

2.2 COMPOSITE FLOOR DECK

A. Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with "SDI Specifications and Commentary for Composite Steel Floor Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
   1. Galvanized and Shop-Primed Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33, G60 zinc coating; with unpainted top surface and cleaned and pretreated bottom surface primed with manufacturer's standard gray baked-on, rust-inhibitive primer.
   2. Profile Depth: As indicated.
   3. Design Uncoated-Steel Thickness: As indicated.
   4. Span Condition: span or more.

2.3 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.

G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

I. Recessed Sump Pans: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch-wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

J. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

K. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

   1. Align cellular deck panels over full length of cell runs and align cells at ends of abutting panels.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 FLOOR-DECK INSTALLATION

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

   2. Weld Spacing: Weld edge ribs of panels at each support. Space additional welds an average of 12 inches apart, but not more than 18 inches apart.
   3. Weld Spacing: Space and locate welds as indicated.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:

   1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:
   1. End Joints: Lapped or butted at Contractor's option.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Field welds will be subject to inspection.

C. Prepare test and inspection reports.

3.5 PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780/A 780M and manufacturer's written instructions.

B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
   1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.

END OF SECTION 05 3100
SECTION 05 4000 – COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Load-bearing wall framing.
   B. Related Sections Include:
      1. Division 05, Section "Metal Fabrications" for masonry shelf angles and connections.
      2. Division 13, Section "Metal Building System."

1.2 ACTION SUBMITTALS
   A. Product Data: For each type of cold-formed steel framing product and accessory.
   B. Shop Drawings:
      1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening
         and anchorage details, including mechanical fasteners.
      2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices,
         accessories, connection details, and attachment to adjoining work.
   C. Delegated-Design Submittal: For cold-formed steel framing.

1.3 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For testing agency.
   B. Welding certificates.

1.4 QUALITY ASSURANCE
   A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
   B. Welding Qualifications: Qualify procedures and personnel according to the following:
      1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.5 DELIVERY, STORAGE, AND HANDLING
   A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery,
      storage, and handling.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ClarkWestern Building Systems, Inc.
   2. Consolidated Fabricators Corp.; Building Products Division.
   3. Dietrich Metal Framing; a Worthington Industries Company.
   4. MarinoWARE.
   5. Nuconsteel; a Nucor Company.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: As indicated.
   2. Deflection Limits: As indicated.

B. Cold-Formed Steel Framing Design Standards:
   2. Wall Studs: AISI S211.
   3. Headers: AISI S212.

C. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.3 COLD-FORMED STEEL FRAMING, GENERAL

A. Steel Sheet: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
   1. Grade: As required by structural performance.
   2. Coating: G60 (G90 at exterior walls).

B. Steel Sheet for Vertical Deflection & Drift Clips: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: G60 (G90 at exterior walls).
2.4 LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch.

B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with straight flanges, and as follows:
   1. Minimum Base-Metal Thickness: Matching steel studs.

C. Steel Box or Back-to-Back Headers: Manufacturer's standard C-shapes used to form header beams, of web depths indicated, unpunched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0538 inch.

2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:
   1. Supplementary framing.
   2. Bracing, bridging, and solid blocking.
   3. Web stiffeners.
   4. Anchor clips.
   5. End clips.
   7. Joist hangers and end closures.
   8. Hole reinforcing plates.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.

C. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
   1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.

D. Welding Electrodes: Comply with AWS standards.
2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.

B. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and coating as framing members supported by shims.

C. Sealer Gaskets: Closed-cell neoprene foam, 1/4 inch (6.4 mm) thick, selected from manufacturer's standard widths to match width of bottom track or rim track members.

2.8 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.

2. Cut framing members by sawing or shearing; do not torch cut.

3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

   a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

   b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

   1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

   2. Squaresness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 PREPARATION

A. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

B. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200 and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.

1. Cut framing members by sawing or shearing; do not torch cut.
2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
   a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, and complying with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

I. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
3.4 LOAD-BEARING WALL INSTALLATION

A. Install continuous top and bottom tracks sized to match studs. Align tracks accurately and securely anchor at corners and ends, and at spacings as follows:

1. Anchor Spacing: To match stud spacing.

B. Squarely seat studs against top and bottom tracks with gap not exceeding of 1/8 inch between the end of wall framing member and the web of track. Fasten both flanges of studs to top and bottom tracks. Space studs as follows:


C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar configurations.

D. Align studs vertically where floor framing interrupts wall-framing continuity. Where studs cannot be aligned, continuously reinforce track to transfer loads.

E. Align floor and roof framing over studs according to AISI S200, Section C1. Where framing cannot be aligned, continuously reinforce track to transfer loads.

F. Anchor studs abutting structural columns or walls, including masonry walls, to supporting structure as indicated.

G. Install headers over wall openings wider than stud spacing. Locate headers above openings as indicated. Fabricate headers of compound shapes indicated or required to transfer load to supporting studs, complete with clip-angle connectors, web stiffeners, or gusset plates.

1. Frame wall openings with not less than a double stud at each jamb of frame as indicated on Shop Drawings. Fasten jamb members together to uniformly distribute loads.

2. Install runner tracks and jack studs above and below wall openings. Anchor tracks to jamb studs with clip angles or by welding, and space jack studs same as full-height wall studs.

H. Install supplementary framing, blocking, and bracing in stud framing indicated to support fixtures, equipment, services, casework, heavy trim, furnishings, and similar work requiring attachment to framing.

1. If type of supplementary support is not indicated, comply with stud manufacturer's written recommendations and industry standards in each case, considering weight or load resulting from item supported.

I. Install horizontal bridging in stud system, spaced vertically 48 inches. Fasten at each stud intersection.

1. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs with a minimum of two screws into each flange of the clip angle for framing members up to 6 inches deep.

2. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

J. Install miscellaneous framing and connections, including supplementary framing, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 FIELD QUALITY CONTROL

A. Testing: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.
C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.6 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions in a manner acceptable to manufacturer and Installer that ensures that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION 05 4000
SECTION 05 5000 – METAL FABRICATIONS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Steel framing and supports for countertops.
   2. Loose bearing and leveling plates, beam seats, and steel door frame supports
   3. Steel framing and supports for mechanical and electrical equipment.
   4. Steel weld plates and angles anchored to concrete not specified in other Sections.
   5. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   6. Miscellaneous steel framing and supports.
   7. Shelf angles.

B. Products furnished, but not installed under this Section:
   1. Loose steel lintels.
   2. Steel weld plates and angles for casting into concrete.
   3. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete.

1.2 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Provide exterior metal fabrications that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.3 SUBMITTALS

A. Product Data: For the following:

   1. Paint products.
   2. Grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.

   1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.
   2. Provide templates for anchors and bolts specified for installation under other Sections.

C. Welding certificates.
1.4 QUALITY ASSURANCE
   A. Welding: Qualify procedures and personnel according to the following:
      1. AWS D1.1, "Structural Welding Code--Steel."
      2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.5 PROJECT CONDITIONS
   A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication and indicate measurements on Shop Drawings.
      1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating metal fabrications without field measurements. Coordinate wall and other contiguous construction to ensure that actual dimensions correspond to established dimensions.
      2. Provide allowance for trimming and fitting at site.

1.6 DELIVERY, STORAGE AND HANDLING
   A. Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.
   B. Store material in a location and manner to avoid damage. Do not stack components. Lay out components on firm foundation material such that bending cannot occur.
   C. Store metal components in a clean dry location, away from uncured concrete, cement, or masonry products, acids, oxidizers, rain water, or any other chemical or substance that might damage the material or finish.
   D. Plan work and storage locations to keep on-site handling to a minimum.
   E. Exercise particular care to avoid damage to material finishes or unprotected surfaces when handling.

1.7 COORDINATION
   A. Coordinate installation of anchorages for metal fabrications. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
   B. Coordinate installation of steel weld plates and angles for casting into concrete that are specified in this Section but required for work of another Section. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 METALS, GENERAL

Metal Surfaces, General: Provide materials with smooth, flat surfaces, unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.
2.2 FERROUS METALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Bars (Pickets): Hot-rolled, carbon steel complying with ASTM A 29/A 29 M, Grade 1010.

D. Steel Tubing: ASTM A 500, cold-formed steel tubing.

E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads.

2.3 NONFERROUS METALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T6.

B. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

C. Bronze Plate, Sheet, Strip, and Bars: ASTM B 36/B 36M, Alloy UNS No. C28000 (muntz metal, 60 percent copper).


2.4 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633, Class Fe/Zn 5, at exterior walls. Provide stainless-steel fasteners for fastening aluminum. Select fasteners for type, grade, and class required.

B. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous casting, either ASTM A 47/A 47M malleable iron or ASTM A 27/A27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

C. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches by length indicated with anchor straps or studs not less than 3 inches long at not more than 8 inches o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

D. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

E. Anchor Bolts: ASTM F 1554, Grade 36.

F. Eyebolts: ASTM A 489.

G. Machine Screws: ASME B18.6.3.


I. Wood Screws: Flat head, ASME B18.6.1.


L. Expansion Anchors: Anchor bolt and sleeve assembly with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.


2.5 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79.

1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

B. Zinc-Rich Primer: Complying with SSPC-Paint 20 or SSPC-Paint 29 and compatible with topcoat.

1. Use primer with a VOC content of 420 g/L (3.5 lb/gal.) or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

E. Non-shrink, Metallic Grout: Factory-packaged, ferrous-aggregate grout complying with ASTM C 1107, specifically recommended by manufacturer for heavy-duty loading applications.

F. Non-shrink, Nonmetallic Grout: Factory-packaged, non-staining, non-corrosive, nongaseous grout complying with ASTM C 1107. Provide grout specifically recommended by manufacturer for interior and exterior applications.

G. Concrete Materials and Properties: Comply with requirements in Division 3 Section "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi, unless otherwise indicated.

2.6 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch, unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work true to line and level with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts, unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

1. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.7 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction, unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction retained by framing and supports. Cut, drill, and tap units to receive hardware, hangers, and similar items.

1. Furnish inserts if units are installed after concrete is placed.

C. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.8 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Weld adjoining members together to form a single unit where indicated.

B. Galvanize loose steel lintels located in exterior walls.

C. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span but not less than 8 inches, unless otherwise indicated.

2.9 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.
C. Prime shelf angles located in exterior walls with zinc-rich primer.
D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.10 LOOSE BEARING AND LEVELING PLATES
A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.
B. Prime plates with zinc-rich primer.

2.11 STEEL WELD PLATES AND ANGLES
A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with not less than two integrally welded steel strap anchors for embedding in concrete.

2.12 MISCELLANEOUS STEEL TRIM
A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.
B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.
   1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.
C. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.13 FINISHES, GENERAL
A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
B. Finish metal fabrications after assembly.

2.14 STEEL AND IRON FINISHES
A. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with minimum requirements indicated below for SSPC surface preparation specifications and environmental exposure conditions of installed metal fabrications:
   1. Exteriors (SSPC Zone 1B) and Items Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Interiors (SSPC Zone 1A): SSPC-SP 3, "Power Tool Cleaning."
B. Shop Priming: Apply shop primer to uncoated surfaces of metal fabrications, except those with galvanized finishes and those to be embedded in concrete, sprayed-on fireproofing, or masonry, unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
C. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123 M for other steel and iron products.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag bolts, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers’ written instructions and requirements indicated on Shop Drawings.

B. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
   1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

C. Install pipe columns on concrete footings with grouted base plates. Position and grout column base plates as specified in "Installing Bearing and Leveling Plates" Article.
   1. Grout base plates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING BEARING AND LEVELING PLATES

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.

1. Use non-shrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use non-shrink, nonmetallic grout in exposed locations, unless otherwise indicated.
2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION 05 5000
SECTION 05 5119 – METAL GRATING STAIRS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Industrial Class stairs with steel-grating treads.
2. Steel railings attached to metal stairs.
3. Steel handrails attached to walls adjacent to metal stairs.
4. Mesh guard at handrails.

1.2 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written instructions to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorages for metal stairs and railings.

1. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry.
2. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Shop Drawings:

1. Include plans, elevations, sections, details, and attachment to other work.
2. Indicate sizes of metal sections, thickness of metals, profiles, holes, and field joints.
3. Include plan at each level.
4. Indicate locations of anchors, weld plates, and blocking for attachment of wall-mounted handrails.

B. Delegated-Design Submittal: For stairs and railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer’s experience with providing delegated-design engineering services of the kind indicated, including documentation that engineer is licensed in the State in which Project is located.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.
1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification.

1. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers.
2. Protect steel members and packaged materials from corrosion and deterioration.
3. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures.
   a. Repair or replace damaged materials or structures as directed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design stairs and railings, including attachment to building construction.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Uniform Load: 100 lbf/sq. ft.
2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
3. Uniform and concentrated loads need not be assumed to act concurrently.
4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
5. Limit deflection of treads, platforms, and framing members to L/360 or 1/4 inch, whichever is less.

C. Structural Performance of Railings: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:
   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
   b. Infill load and other loads need not be assumed to act concurrently.
2.2 METALS

A. Metal Surfaces: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

D. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.

E. Steel Wire Rod for Grating Crossbars: ASTM A 510/A 510M.

F. Steel Tubing for Railings: ASTM A 500/A 500M (cold formed) or ASTM A 513/A 513M.

G. Steel Pipe for Railings: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

2.3 FASTENERS

A. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.

C. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941/F 1941M, Class Fe/Zn 5, unless otherwise indicated.

2.4 MISCELLANEOUS MATERIALS

A. Welding Electrodes: Comply with AWS requirements.

B. Shop Primers: Provide primers that comply with Section 09 9125 "Painting."

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

1. Join components by welding unless otherwise indicated.

2. Use connections that maintain structural value of joined pieces.

B. Assemble stairs and railings in shop to greatest extent possible.
1. Disassemble units only as necessary for shipping and handling limitations.
2. Clearly mark units for reassembly and coordinated installation.

C. Cut, drill, and punch metals cleanly and accurately.
   1. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated.
   2. Remove sharp or rough areas on exposed surfaces.

D. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

E. Form exposed work with accurate angles and surfaces and straight edges.

F. Weld connections to comply with the following:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. Weld exposed corners and seams continuously unless otherwise indicated.
   5. At exposed connections, finish exposed welds to comply with NOMMA’s "Voluntary Joint Finish Standards" for Finish # 3 - Partially dressed weld with spatter removed.

G. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
   1. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated.
   2. Locate joints where least conspicuous.
   3. Fabricate joints that are exposed to weather in a manner to exclude water.
   4. Provide weep holes where water may accumulate internally.

2.6 FABRICATION OF STEEL-FRAMED STAIRS

A. NAAMM Stair Standard: Comply with NAAMM AMP 510, "Metal Stairs Manual," for Industrial Class, unless more stringent requirements are indicated.

B. Stair Framing:
   1. Fabricate stringers of steel channels.
      a. Stringer Size: As required to comply with "Performance Requirements" Article.
      b. Provide closures for exposed ends of channel stringers.
      c. Finish: Painted.
   2. Construct platforms and tread supports of steel channel headers and miscellaneous framing members as required to comply with "Performance Requirements" Article.
      a. Provide closures for exposed ends of channel framing.
      b. Finish: Painted.
   3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers.
   4. Where stairs are enclosed by gypsum board assemblies, provide hanger rods or struts to support landings from floor construction above or below.
a. Locate hanger rods and struts where they do not encroach on required stair width and are within the fire-resistance-rated stair enclosure.

5. Where masonry walls support metal stairs, provide temporary supporting struts designed for erecting steel stair components before installing masonry.

C. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."

1. Fabricate treads and platforms from welded steel grating with 1-1/4-by-3/16-inch bearing bars at 15/16 inch on center bearing bars at 11/16 inch on center and crossbars at 4 inches on center.
   a. Surface: Plain.
   b. Finish: Painted.

2. Fabricate grating platforms with nosing matching that on grating treads.
   a. Secure grating to platform framing by welding.

D. Risers: Open.

2.7 FABRICATION OF STAIR RAILINGS

A. Fabricate railings to comply with requirements indicated for design, dimensions, details, finish, and member sizes, including wall thickness of member, post spacings, wall bracket spacing, and anchorage, but not less than that needed to withstand indicated loads.

B. Welded Connections: Fabricate railings with welded connections.

1. Fabricate connections that are exposed to weather in a manner that excludes water.
   a. Provide weep holes where water may accumulate internally.

2. Cope components at connections to provide close fit, or use fittings designed for this purpose.
3. Weld all around at connections, including at fittings.
4. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
5. Obtain fusion without undercut or overlap.
6. Remove flux immediately.
7. Finish welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #3 - Partially dressed weld with spatter removed as shown in NAAMM AMP 521.

C. Form changes in direction of railings as follows:

1. As detailed.
2. By bending or by inserting prefabricated elbow fittings.
3. By flush bends or by inserting prefabricated flush-elbow fittings.
4. By radius bends of radius indicated or by inserting prefabricated elbow fittings of radius indicated.

D. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

E. Close exposed ends of railing members with prefabricated end fittings.
F. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.
   1. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

G. Connect posts to stair framing by direct welding unless otherwise indicated.

H. Metal Mesh Guard: 1-1/2" x 1-1/2" x 1/8" mesh. See Drawings.

2.8 FINISHES

A. Finish metal stairs after assembly.

B. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with SSPC-SP 3, "Power Tool Cleaning"
   1. Exterior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Interior Stairs: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   3. Interior Stairs: SSPC-SP 3, "Power Tool Cleaning."

C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify elevations of floors, bearing surfaces and locations of bearing plates, and other embedments for compliance with requirements.
   1. For wall-mounted railings, verify locations of concealed reinforcement within gypsum board and plaster assemblies.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLING METAL STAIRS

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction.
   1. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.

B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Install metal stairs by welding stair framing to steel structure or to weld plates cast into concrete unless otherwise indicated.
a. Clean bottom surface of baseplates.
b. Set steel-stair baseplates on wedges, shims, or leveling nuts.
c. After stairs have been positioned and aligned, tighten anchor bolts.
d. Do not remove wedges or shims, but if protruding, cut off flush with edge of bearing plate before packing with grout.
e. Promptly pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

1) Neatly finish exposed surfaces; protect grout and allow to cure.
2) Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

D. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

E. Fit exposed connections accurately together to form hairline joints.

1. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations.
2. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.
3. Comply with requirements for welding in "Fabrication, General" Article.

3.3 INSTALLING RAILINGS

A. Adjust railing systems before anchoring to ensure matching alignment at abutting joints with tight, hairline joints.

1. Space posts at spacing indicated or, if not indicated, as required by design loads.
2. Plumb posts in each direction, within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of stairs for sloping members do not exceed 1/4 inch in 12 feet.
4. Secure posts and rail ends to building construction as follows:

   a. Anchor posts to steel by welding or bolting to steel supporting members.
   b. Anchor handrail ends to concrete and masonry with steel round flanges welded to rail ends and anchored with post-installed anchors and bolts.

3.4 REPAIR

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION 05 5119
SECTION 06 1000 – ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Wood furring.
   2. Blocking.
   3. Plywood backing panels.

1.2 SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
   3. Provide dressed lumber, S4S, unless otherwise indicated.

2.2 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

   1. Blocking.
   2. Nailers.
   3. Cants.
   4. Furring.
   5. Grounds.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 19 percent maximum moisture content of any species.

C. For concealed boards, provide lumber with 15 percent maximum moisture content and any of the following species and grades:

   1. Mixed southern pine, No. 2 grade; SPIB.
   2. Eastern softwoods, No. 2 Common grade; NeLMA.
   3. Northern species, No. 2 Common grade; NLGA.
4. Western woods, Construction or No. 2 Common grade; WCLIB or WWPA.

2.3 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated where indicated, in thickness indicated or, if not indicated, not less than 1/2-inch nominal thickness.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.


C. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

2.5 MISCELLANEOUS MATERIALS

A. Sill-Sealer Gaskets: Glass-fiber-resilient insulation, fabricated in strip form, for use as a sill sealer; 1-inch nominal thickness, compressible to 1/32 inch; selected from manufacturer's standard widths to suit width of sill members indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.

END OF SECTION 06 1000
SECTION 06 1600 – SHEATHING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wall sheathing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated plywood complies with requirements. Include physical properties of treated materials.
3. For fire-retardant treatments, include physical properties of treated plywood both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D 5516.
4. For products receiving waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Stack panels flat with spacers beneath and between each bundle to provide air circulation. Protect sheathing from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance Ratings: As tested according to ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.
2.2 WOOD PANEL PRODUCTS

A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

B. Factory mark panels to indicate compliance with applicable standard.

2.3 WALL SHEATHING

A. Plywood Sheathing: DOC PS 1, sheathing as indicated.
   1. Span Rating: as indicated.
   2. Nominal Thickness: as indicated.

B. Oriented-Strand-Board Sheathing: DOC PS 2, sheathing as indicated.
   1. Span Rating: as indicated.
   2. Nominal Thickness: as indicated.

C. Glass-Mat Gypsum Wall Sheathing: ASTM C 1177/1177M.
   1. Product: Subject to compliance with requirements, provide “Dens-Glass Gold” by G-P Gypsum, or approved equal.
   2. Core: 5/8 inch, unless indicated otherwise.
   3. Type X.
   4. In locations indicated on Drawings.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with drawings:
D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.
E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.
F. Coordinate sheathing installation with installation of materials installed over sheathing so sheathing is not exposed to precipitation or left exposed at end of the workday when rain is forecast.

3.2 WOOD STRUCTURAL PANEL INSTALLATION


B. Fastening Methods: Fasten panels as indicated below:

   1. Wall Sheathing:
      a. Screw to cold formed steel framing.
      b. Space panels 1/8 inch apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer’s written instructions.

   1. Fasten gypsum sheathing to wood framing with nails.
   2. Fasten gypsum sheathing to cold-formed metal framing with screws.
   3. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Seal sheathing joints according to sheathing manufacturer’s written instructions.

   1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
   2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

END OF SECTION 06 1600
SECTION 07 1113 – BITUMINOUS DAMPROOFING

PART 1 - GENERAL

1.1 SUMMARY
   A. This Section includes the following:
      1. Cold-applied, emulsified asphalt dampproofing.

1.2 SUBMITTALS
   A. Product Data: For each type of product indicated.

1.3 PROJECT CONDITIONS
   A. Ventilation: Provide adequate ventilation during application of dampproofing in enclosed spaces. Maintain ventilation until dampproofing has cured.

PART 2 - PRODUCTS

2.1 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPROOFING
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. BASF Construction Chemicals – Building Systems; Sonneborn Brand Products.
      2. Brewer Company (The).
      3. ChemMasters Corp.
      4. Euclid Chemical Company (The); an RPM company.
      5. Gardner Gibson, Inc.
      8. Koppers Inc.
     11. Tamms Industries, Inc.

   B. Trowel Coats: ASTM D 1227, Type II, Class 1.
   C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
   D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.
   E. VOC Content: Zero.
2.2 PROTECTION COURSE

A. Protection Course, Asphalt-Board Type: ASTM D 6506, premolded, 1/8-inch-thick, multi-ply, semirigid board consisting of a mineral-stabilized asphalt core sandwiched between layers of asphalt-saturated felt, and faced on 1 side with polyethylene film.

2.3 MISCELLANEOUS MATERIALS

A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.

C. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.

3.2 APPLICATION, GENERAL

A. Comply with manufacturer’s written instructions for substrate preparation, dampproofing application, cure time between coats, and drying time before backfilling, unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.

1. Apply dampproofing to provide continuous plane of protection.

2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of six (6) inches over outside face of footing.

1. Extend dampproofing 12 inches onto intersection walls and footings, but do not extend onto surfaces exposed to view when Project is completed.

2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where shown as "reinforced," by embedding an 8-inch-wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

C. Where dampproofing exterior face of inner wythe of exterior masonry cavity walls, lap dampproofing at least 1/4 inch onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.

1. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe.

2. Lap dampproofing at least 1/4 inch onto shelf angles supporting veneer.
D. Where dampproofing interior face of above-grade, exterior concrete and masonry walls, continue dampproofing through intersecting walls by keeping vertical mortar joints at intersection temporarily open or by dampproofing wall before constructing intersecting walls.

3.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. On Concrete Foundations: Apply 2 brush or spray coats at not less than 1.5 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat, 1 fibered brush or spray coat at not less than 3 gal./100 sq. ft., or 1 trowel coat at not less than 4 gal./100 sq. ft.

3.4 INSTALLATION OF PROTECTION COURSE

A. Install protection course over completed-and-cured dampproofing. Comply with dampproofing material manufacturer's written recommendations for attaching protection course.

1. Support protection course with spot application of adhesive of type recommended by protection board manufacturer over cured coating.
2. Install protection course on same day of installation of dampproofing (while coating is tacky) to ensure adhesion.

END OF SECTION 07 1113
SECTION 07 2100 – THERMAL INSULATION

PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Perimeter insulation under slabs-on-grade.
   2. Perimeter wall insulation.
   3. Foundation insulation.
   4. Wall insulation at framed wall.
   5. Vapor retarders at frame walls.

B. Related Sections include:
   1. Division 13, Section “Metal Building Systems” for insulation and vapor retarders for metal building.

1.2 SUBMITTALS

A. Section 01 3300 – Submittal Procedures.
B. Product Data: For each type of product indicated.
C. Product test reports.
D. Research/Evaluation Reports: For foam-plastic insulation.

1.3 QUALITY ASSURANCE

A. Retain ASTM test method below based on product and kind of fire-resistance characteristic specified for each product in Part 2. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84 for surface-burning characteristics, by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, 1.60 lb/cu. ft., with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:

   1. Manufacturers:
      a. DiversiFoam Products.
      b. Amofoam.
      c. Dow Chemical Company.
      d. Owens Corning.
      e. U.C. Industries.
      f. Minnesota Diversified.
B. Polyisocyanurate Board Insulation: ASTM C 1289, Type I, Class 1, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, based on test performed on unfaced core on thicknesses up to 4 inches.

1. Manufacturers:
   b. Dow Chemical Corporation.
   c. Rmax, Inc.
   d. Carlisle Coting & Waterproofing
   e. Approved Equal.

2.3 GLASS-FIBER BLANKET INSULATION

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

   1. Certain Teed Corporation.
   2. Johns Manville.
   3. Owens Corning.

B. Unfaced, Glass-Fiber Blanket Insulation: ASTM C665, Type I; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively, per ASTM E 84; passing ASTM E 136 for combustion characteristics.

C. Foil-Faced, Glass-Fiber Blanket Insulation: ASTM C 665, Type III, Class B; consisting of fibers; with maximum flame-spread and smoke-developed indexes of 15 and 50, respectively; passing ASTM E 136 for combustion characteristics.

2.4 VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D 4397, with maximum permeance rating of 0.10 perm.

2.5 AUXILIARY INSULATING MATERIALS

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

B. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

C. Single-Component Nonsag Urethane Sealant: ASTM C 920, Type I, Grade NS, Class 25, Use NT related to exposure, and Use O related to vapor-retarder-related substrates.

E. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and with demonstrated capability to bond vapor retarders securely to substrates indicated

F. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

G. Impaling Pins: Impaling pins shall be self-adhering wire pins with sheet metal retaining clips and protective rubber tips. Adhesive for pins shall be as recommended by the pin manufacturer.

H. Joint Tape: Compatible for type of insulation board facing used.
2.6 INSULATION FASTENERS

A. Adhesively Attached, Spindle-Type Anchors: Plate formed from perforated galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square, welded to projecting copper-coated steel spindle 0.105 inch in diameter and of length capable of holding insulation of thickness indicated securely in position with 1-1/2-inch square or diameter self-locking washers complying with the following requirements:

1. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick galvanized steel sheet, with beveled edge for increased stiffness.
2. Where anchors are located in attic spaces Insert location, protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap.

B. Anchor Adhesive: Product with demonstrated capability to bond insulation anchors securely to substrates indicated without damaging insulation, fasteners, and substrates.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.2 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Set vapor-barrier-faced units with vapor barrier to warm-in-winter side of construction, unless otherwise indicated.

1. Tape joints and ruptures in vapor barrier, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.

C. Install mineral-fiber insulation in cavities formed by framing members according to the following requirements:

1. Use insulation widths and lengths that fill the cavities formed by framing members. If more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
2. Place insulation in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.
3. Maintain 3-inch clearance of insulation around recessed lighting fixtures.
4. Install eave ventilation troughs between roof framing members in insulated attic spaces at vented eaves.
5. For metal-framed wall cavities where cavity heights exceed 96 inches, support unfaced blankets mechanically and support faced blankets by taping flanges of insulation to flanges of metal studs.

D. Install board insulation on concrete substrates by adhesively attached, spindle-type insulation anchors as follows:

1. Fasten insulation anchors to concrete substrates with insulation anchor adhesive according to anchor manufacturer's written instructions. Space anchors according to insulation manufacturer's written instructions for insulation type, thickness, and application indicated.
2. Apply insulation standoffs to each spindle to create cavity width indicated between concrete substrate and insulation.
3. After adhesive has dried, install board insulation by pressing insulation into position over spindles and securing it tightly in place with insulation-retaining washers, taking care not to compress insulation below indicated thickness.

4. Where insulation will not be covered by other building materials, apply capped washers to tips of spindles.

3.3 INSTALLATION OF PERIMETER AND UNDER-SLAB INSULATION

A. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

B. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.

C. Protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.4 INSTALLATION OF FOUNDATION INSULATION

A. Install insulation in areas and in thicknesses indicated or required to produce R-valued indicated. Cut and fit tightly around obstructions and fill voids with insulation.

   1. Tape joints on exterior walls to assure tight joints.

B. Review wall types, sections, and details as defined on the Drawings for locations of building insulation materials.

C. Verify that site conditions are ready to receive insulation materials.

D. Protect insulation board from damage and UV exposure.

3.5 INSTALLATION OF VAPOR RETARDERS

A. General: Extend vapor retarder to extremities of areas to be protected from vapor transmission. Secure in place with adhesives or other anchorage system as indicated. Extend vapor retarder to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

B. Seal vertical joints in vapor retarders over framing by lapping not less than two wall studs. Fasten vapor retarders to wood framing at top, end, and bottom edges; at perimeter of wall openings; and at lap joints. Space fasteners 16 inches o.c.

C. Before installing vapor retarder, apply urethane sealant to flanges of metal framing including runner tracks, metal studs, and framing around door and window openings. Seal overlapping joints in vapor retarders with vapor-retarder tape according to vapor-retarder manufacturer’s written instructions. Seal butt joints with vapor-retarder tape. Locate all joints over framing members or other solid substrates.

D. Firmly attach vapor retarders to metal framing and solid substrates with vapor-retarder fasteners as recommended by vapor-retarder manufacturer.

E. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.

F. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarder.

END OF SECTION 07 2100
SECTION 07 2500 – WEATHER BARRIERS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Building wrap (air/moisture barrier).
   2. Flexible flashing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For water-resistive barrier and flexible flashing from ICC-ES.

PART 2 - PRODUCTS

2.1 WEATHER-RESISTIVE BARRIER

A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

   1. Products: Subject to compliance with requirements, provide products by one of the following manufacturers:
       a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
       b. DuPont (E. I. du Pont de Nemours and Company); Tyvek CommercialWrap.
       c. Ludlow Coated Products; Barricade Building Wrap.
       d. Pactiv, Inc.; GreenGuard C500.
       e. Raven Industries Inc.; Fortress Pro Weather Protective Barrier.
       g. Approved Equal.

   2. Water-Vapor Permeance: Not less than 50 g through 1 sq. m of surface in 24 hours per ASTM E 96/E 96M, Desiccant Method (Procedure A).

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Self-adhesive butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
1. Products: Subject to compliance with requirements, provide products by one of the following manufacturers:
   a. DuPont (E. I. du Pont de Nemours and Company); DuPont Flashing Tape.
   c. Protecto Wrap Company; BT-25 XL.
   d. Raven Industries Inc.; Fortress Flashshield.
   e. Approved equal.

PART 3 - EXECUTION

3.1 WEATHER-RESISTIVE BARRIER INSTALLATION

A. Cover sheathing with water-resistive barrier as follows:
   1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
   2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.

B. Building Wrap: Comply with manufacturer's written instructions.
   1. Seal seams, edges, fasteners, and penetrations with tape.
   2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
   1. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
   2. Lap flashing over water-resistive barrier at bottom and sides of openings.
   3. Lap water-resistive barrier over flashing at heads of openings.

END OF SECTION 07 2500
SECTION 07 7253 – SNOW GUARDS

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Snow guards for standing seam metal roofs.
   2. Non-penetrating attachment system.

   B. Related Sections:
   1. Division 13 Section “Metal Building Systems.”

1.2 REFERENCES
A. Aluminum Associates (AA) – Aluminum Standards and Data, most recent edition.

   B. ASTM International (ASTM):

1.3 SYSTEM DESCRIPTION
A. Attachment system to provide attachment to standing seam metal roofs:
   1. With only minor dimpling of panel seams.
   2. Without penetrations through roof seams or panels.
   3. Without use of sealers or adhesives.
   4. Without voiding roof warranty.
   5. For two (2) rows of snows guards.

   B. Loading: Design snow guard system to resist minimum in-service snow loads as indicated on Drawings.

   C. Factor of safety: Utilize a factor of safety  ≥ 2 to determine allowable loads from ultimate tested clamp tensile load values.

1.4 SUBMITTALS
A. Submittals for Review:
   1. Shop Drawings: Show locations of snow guards on roof and attachment spacing.
   2. Product Data: Submit manufacturer’s specifications, standard detail drawings, installation instructions, and recommended layout.
   3. Samples:
      a. Clamp samples.
      b. 24-inch-long cross member samples including coupler and other hardware.

   B. Quality Control Submittals:
   1. Test Results: Results of product load testing, issued by a recognized independent testing laboratory, showing load-to-failure value of attachment.
C. Closeout Submittals:
   1. Certification: Installer's certification that snow guard system was installed in accordance with manufacturer's instructions and approved Shop Drawings.

1.5 WARRANTY
A. Manufacturer’s Standard Warranty: Manufacturer’s standard form in which manufacturer warrants its products shall be free from material defects and agrees to replace any goods that are defective.
B. Installer’s Warranty: Installer shall provide a two (2) years workmanship warranty, in which he agrees to replace or repair any defects due to improper installation.

1.6 DELIVERY, STORAGE AND HANDLING
A. Inspect materials upon delivery and order replacements for any missing or defective items.
B. Keep materials dry, covered, and off the ground until installed.

1.7 COORDINATION
A. Coordinate installation of snow guards with roof installation to assure proper placement of the snow guards.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Basis-of-Design Product: Subject to compliance with requirements, provide SnoRail and SnoFence systems manufactured by Metal Roof Innovations, Ltd.
B. Substitutions: Under provisions of Division 01, “Product Substitutions.”

2.2 COMPONENTS
A. Clamps:
   1. Manufactured from 6061-T6 aluminum extrusions conforming to ASTM B221 or aluminum castings conforming to ASTM B85 and to AA Aluminum Standards and Data.
   2. Clamp model: No. S-5-A and S-5-AE.
   3. Set screws: 300 Series stainless steel, 18-8 alloy, 3/8 inch diameter, with round nose point.
B. Cross Members and Posts:
   1. Manufactured from aluminum.
   2. Provide coupler ensuring alignment and structural continuity at end joints.
C. SnoClips: Aluminum, with rubber foot, minimum three (3) inches wide.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Prior to beginning installation, verify that:
   1. Panel seaming is complete.
   2. Panel attachment is sufficient to withstand loads applied by snow guard system.
   3. Installation will not impede roof drainage.

3.2 PREPARATION

A. Clean areas to receive attachments; remove loose and foreign matter that could interfere with installation or performance.

3.3 INSTALLATION

A. Install system in accordance with manufacturer's instructions and approved Shop Drawings.
B. Place clamps at maximum 24 inches on center or as required by in-service loads.
C. Place clamps in straight, aligned rows.
D. Place both set screws on same side of clamp.
E. Tighten set screws to manufacturer's recommended torque.
F. Use S-5-AE clamps in lieu of standard clamp at each end of each assembly, and at a frequency and spacing of one for each 50 feet of assembly.
G. Install cross members through holes in clamps.
H. Install couplers at cross member end joints.
I. Tighten set screws against cross members at all "E" clamp locations.
J. Do not cantilever cross members more than 3 inches beyond last clamp at ends.
K. Install one or two SnoClips per panel between panel seams.

3.4 PROTECTION

A. Protect installed products until completion of Project.
B. Touc-up, repair, or replace damaged products before Substantial Completion.

END OF SECTION 07 7253
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in vertical surfaces and horizontal nontraffic surfaces.
2. Exterior joints in horizontal traffic surfaces.
3. Interior joints in vertical surfaces and horizontal nontraffic surfaces.
4. Interior joints in horizontal traffic surfaces.
5. Acoustical joint sealants.
6. Refer to Drawings and Joint Sealant Schedule at the end of this section for specific joint locations and sealant types.

1.2 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.3 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Samples for initial selection: For each type of sealant provide samples of full range of manufacturers available colors.

C. Samples: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Compatibility and Adhesion Test Reports: From sealant manufacturer for the following:

1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.

E. Product Test Reports: From a qualified testing agency indicating sealants comply with requirements, based on comprehensive testing of current production formulations.

F. Warranties: Special warranties listed in this Section.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An experienced Installer who has specialized in installing joint sealants similar in material, design, and extent to those indicated for this Project and whose work has resulted in joint-sealant installations with a record of successful in-service performance.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.
C. Preinstallation Conference: Conduct conference at Project site.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to the Project site in original, unopened containers or bundles with labels indicating manufacturer, product name and designation, color, expiration date, pot life, curing time, and mixing instructions for multicomponent materials.

B. Store and handle materials in compliance with manufacturer’s written instructions to prevent their deterioration or damage due to moisture, high or low temperatures, contaminants, or other causes.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with installation or joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 40 deg F.
   2. When joint substrates are wet.

B. Joint-Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.

C. Joint-Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

1.7 WARRANTY

A. Special Installer’s Warranty: Manufacturer’s standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance or other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer’s Warranty: Manufacturer’s standard form in which joint sealer manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance or other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 2 articles.

2.2 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.
B. VOC Content of Interior Sealants: Provide interior sealants and sealant primers that comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Suitability for Immersion in Liquids: Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

F. Color of Exposed Joint Sealants: Sealant, generally, shall be the color of the adjacent material which lies in the same plane as the sealant. Verify all colors with Architect prior to installation.

2.3 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be non-staining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Immersion in Liquids. Where elastomeric sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247 and qualify for the length of exposure indicated by reference to ASTM C 920 for Class 1 or 2. Liquid used for testing sealants is deionized water, unless otherwise indicated.

D. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food; provide products that comply with 21 CFR 177.2600.

E. One part polyurethane, two parts polymer, or one part low-modulus silicone sealants at all exterior and interior joints, except horizontal traffic surfaces, in which case acceptable products are as follows:

1. Products:
   a. Sika “Sikaflex-1a”.
   b. Sonneborn “Sollastic NP I or NP II”.
   c. Tremco Manufacturing Company “Dymeric” or “Dymonic”.
   d. Pecora “Dynatrol II”.
   e. G.E. “Silpruf”.
   f. Dow Corning “790”.
2.4 SILICONE JOINT SEALANTS

A. Mildew-Resistant Silicone Joint Sealant: ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. BASF Building Systems.
   b. Dow Corning Corporation.
   c. GE Advanced Materials - Silicones.
   d. May National Associates, Inc.
   e. Pecora Corporation.
   f. Polymeric Systems, Inc.
   g. Schnee-Morehead, Inc.
   h. Sika Corporation; Construction Products Division.
   i. Tremco Incorporated.

2. Type: Single component.
3. Grade: nonsag.
4. Class: 100/50

2.5 URETHANE JOINT SEALANTS

A. Urethane Joint Sealant: ASTM C 920.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. BASF Building Systems.
   b. Bostik, Inc.
   d. May National Associates, Inc.
   e. Pacific Polymers International, Inc.
   f. Pecora Corporation.
   g. Polymeric Systems, Inc.
   h. Schnee-Morehead, Inc.
   i. Sika Corporation; Construction Products Division.
   j. Tremco Incorporated.

2. Grade: Pourable.
3. Class: 50.

2.6 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. BASF Building Systems.
   b. Bostik, Inc.
   c. May National Associates, Inc.
   d. Pecora Corporation.
2.7 ACOUSTICAL JOINT SEALANTS

A. Manufacturer’s standard nonsag, paintable, nonstaining latex sealant complying with ASTM C919. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.

B. Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following:
   1. Specified Technologies, Inc; Smoke N Sound Acoustical Sealant.
   2. Accumetric LLC; BOXX 824 Acoustical Sound Sealant.
   4. Grabber Acoustical Sealant GSC.
   5. Pecora Corporation.
   6. USG Corporation.

C. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.8 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

C. Elastomeric Tubing Sealant Backings: Neoprene, butyl, EPDM, or silicone tubing complying with ASTM D 1056, nonabsorbent to water and gas, and capable of remaining resilient at temperatures down to minus 26 deg F. Provide products with low compression set and of size and shape to provide a secondary seal, to control sealant depth, and to otherwise contribute to optimum sealant performance.

D. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.9 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Non-staining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants.

   1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant.
      a. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air.

   2. Remove laitance and form-release agents from concrete.
      a. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

   3. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION

A. General: Comply with manufacturer's written instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

   1. Do not leave gaps between ends of sealant backings.
   2. Do not stretch, twist, puncture, or tear sealant backings.
   3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.
E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
   1. Place sealants so they directly contact and fully wet joint substrates.
   2. Completely fill recesses in each joint configuration.
   3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

G. Tooling of Non-sag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
   1. Remove excess sealant from surfaces adjacent to joints.
   2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
   3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.

H. Installation of Preformed Silicone-Sealant System: Comply with manufacturer's written instructions.

I. Installation of Preformed Foam Sealants: Install each length of sealant immediately after removing protective wrapping, taking care not to pull or stretch material, producing seal continuity at ends, turns, and intersections of joints. For applications at low ambient temperatures where expansion of sealant requires acceleration to produce seal, apply heat to sealant in compliance with sealant manufacturer's written instructions.


K. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
   1. Extent of Testing: Test completed and cured sealant joints as follows:
      a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
      b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.

B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces.
   1. Joint Locations:
a. Isolation and contraction joints in cast-in-place concrete slabs.
b. Other joints as indicated.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.


1. Joint Locations:
   b. Joints between plant-precast architectural concrete units.
   c. Control and expansion joints in unit masonry.
   d. Joints in exterior insulation and finish systems.
   e. Joints between metal panels where indicated.
   f. Joints between different materials listed above.
   g. Perimeter joints between materials listed above and frames of doors, windows and louvers.
   h. Control and expansion joints in ceilings, soffits and other overhead surfaces.
   i. Other joints as indicated.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.

1. Joint Locations:
   b. Control and expansion joints in tile flooring.
   c. Other joints as indicated.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.


1. Joint Locations:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Tile control and expansion joints.
   d. Vertical joints (non-fire-rated) on exposed surfaces of interior unit masonry and concrete walls and partitions.
   e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
   f. Other joints as indicated.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces.

1. Joint Sealant Location:
   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.
   c. Other joints as indicated.
3. Joint Sealant Color: As selected by Architect from manufacturer’s full range of colors.

F. Joint Sealant Application: Interior acoustical joints in vertical surfaces and horizontal nontraffic surfaces.
   1. Joint Sealant Location:
      a. Acoustical joints where indicated.

3. Joint Sealant Color: As selected by Architect from manufacturer’s full range of colors.

3.6 CLEANING
   A. Remove masking tape.
   B. Clean adjacent surfaces soiled by sealant installation.

3.7 PROTECTION
   A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired joint sealants are indistinguishable from the original work.

END OF SECTION 07 9200
SECTION 08 1113 – HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Standard interior hollow metal doors and frames.

B. Related Sections include the following:
   1. Division 04 Section “Concrete Unit Masonry” for building anchors into and grouting hollow metal frames in masonry construction.
   2. Division 08 Section “Flush Wood Doors” for wood doors installed in hollow metal frames.
   3. Division 08 Section “Glazing” for glazed lites in hollow metal doors.
   4. Division 08 Section “Door Hardware” for door hardware for hollow metal doors.
   5. Division 09 Section “Painting” for field painting hollow metal doors and frames.

1.2 DEFINITIONS

A. Minimum Thickness: Minimum thickness of base metal without coatings.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance rating, and finishes for each type of steel door and frame and window frame specified.

B. Shop Drawings: In addition to requirements below, provide a schedule of hollow metal doors and frames and window frames using the same reference numbers for details and openings as those on Drawings:
   1. Elevations of each door and window design.
   2. Details of doors and windows, including vertical and horizontal edge details.
   3. Frame details for each frame type, including dimensioned profiles.
   4. Details and locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of anchorages, accessories, joints, and connections.
   7. Details of glazing frames and stops showing glazing.
   8. Details of conduit and preparations for electrified door hardware and controls.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer.

C. Fire-Rated Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C. Label each individual glazed light.
1. Temperature-Rise Limit: At exit enclosures and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F above ambient after 30 minutes of fire exposure.

D. Fire-Rated, Borrowed-Light Assemblies: Complying with NFPA 80 and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing according to NFPA 257 or UL 9.

E. Smoke-Control Door Assemblies: Provide an assembly with gaskets listed and labeled for smoke control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784, and installed in compliance with NFPA 105.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- high wood blocking. Avoid using non-vented plastic or canvas shelters that could create a humidity chamber.

1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on Shop Drawings.

1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating hollow metal frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Steelcraft.
2. Curries Company.
3. Firedoor Corporation.
4. Mesker Door.
5. Security Metal Products.
6. Approved equal.
2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 metallic coating.

D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized.

E. Supports and Anchors.

F. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.

G. Inserts, Bolts, and Fasteners.

H. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal door frames of type indicated.

I. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/cu. ft. density; with maximum flame-spread and smoke-developed indexes of 25 and 50 respectively; passing ASTM E 136 for combustion characteristics.

J. Grout: ASTM C476, except with a maximum slump of four (4) inches, as measured according to ASTM C 143/C 143 M.

K. Glazing: Comply with requirements in Division 08 Section "Glazing."

L. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type non-corrosive compound free of asbestos fibers, sulfur components, and other impurities.

2.3 STANDARD HOLLOW METAL DOORS

A. General: Provide doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with SDI A250.8.

B. Design: As indicated on Drawings.
   1. Core Construction: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces door complying with A250.8.
      a. Fire Door Core: As required to provide fire-protection ratings indicated.
      b. Thermal-Rated (Insulated) Doors: Where indicated, provide doors fabricated with thermal-resistance value (R-value) of not less than 4.17 when tested according to ASTM C 1363.
   2. Vertical Edges for Single-Acting Doors: Beveled edge unless square edge is indicated.
      a. Beveled edge: 1/8 inch in 2 inches.
3. Top and Bottom Edges: Closed with flush or inverted 0.042-inch-thick, end closures or channels of same material as face sheets.

C. Interior Doors: Face sheets fabricated from cold-rolled steel sheet. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical-endurance level:
   1. Level 2 and Physical Performance Level C (Standard Duty), Model 1 (Full Flush).
   2. Width: As indicated on Drawings.

D. Hardware Reinforcement: Fabricate reinforcement plates from same material as door face sheets to comply with the following minimum sizes:
   1. Hinges: Minimum 0.123 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
   2. Pivots: Minimum 0.167 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
   3. Lock Face Closers, and Concealed Holders: Minimum 0.067 inch thick.
   4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Interior Frames: Fabricated from cold-rolled steel sheet unless otherwise indicated.
   1. Fabricate interior frames with mitered or coped and welded corners for field assembly as indicated on drawings.
   2. Steel Sheet Thickness for Interior Doors: 0.053-inch-thick, unless otherwise indicated.
   3. Frames for Wood Doors: 0.053-inch-thick steel sheet.
   4. Frames for Borrowed Lights: 0.053-inch-thick steel sheet.
   5. Knockdown frames may be used on interior doors, excluding basement and stair doors, provided that the metal gage meets or exceeds the above specifications and the required fire ratings are met.

C. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:
   1. Hinges: Minimum 0.123 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
   2. Pivots: Minimum 0.167 inch thick by 1-1/2 inches wide by 6 inches longer than hinge, secured by not less than 6 spot welds.
   3. Lock Face Closers, and Concealed Holders: Minimum 0.067 inch thick.
   4. All Other Surface-Mounted Hardware: Minimum 0.067 inch thick.

D. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.

E. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.5 FRAME ANCHORS

A. Jamb Anchors:
1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042-inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.1777-inch thick.
2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042-inch thick.
3. Compression Type for Drywall Slip-on-Frames: Adjustable compression anchors.
4. Post-Installed Expansion Type for In-Place Concrete or Masonry: Minimum 3/8-inch diameter bolts with expansion shields or inserts. Provide pipe spacer from frame to wall, with throat reinforcement plate, welded to frame at each anchor location.

B. Floor Anchors: Formed from same material as frames, 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.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch high unless otherwise indicated.

2.6 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.
D. Terminated Stops: Where indicated, terminate stops 6 inches above finish floor with a 45-degree angle cut, and close open end of stop with steel sheet closure. Cover opening in extension of frame with welded-steel filler plate, with welds ground smooth and flush with frame.

2.7 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.
C. Grout Guards: Formed from same material as frames, not less than 0.016-inch-thick.

2.8 HOLLOW METAL PANELS

A. Provide hollow metal panels of same materials, construction, and finish as specified for adjoining hollow metal work.

2.9 FABRICATION

A. General: Fabricate standard hollow metal doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer’s plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
B. Tolerances: Fabricate hollow metal work to tolerances indicated in SD 117.
C. Hollow Metal Doors:
   2. Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated.

D. 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. Grout Guards: Provide where mortar might obstruct hardware operation.
   5. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
   6. Jamb Anchors: Provide number and spacing of anchors as follows:
      a. Masonry 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 from 60 to 90 inches high.
         2) Four anchors per jamb from 90 to 120 inches high.
         3) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
      b. 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) Four anchors per jamb from 60 to 90 inches high.
         2) Five anchors per jamb from 90 to 96 inches high.
         3) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
         4) Two anchors per head for frames more than 42 inches wide and mounted in metal-stud partitions.
      c. Compression Type: Not less than two anchors in each jamb.
      d. Post-Installed Expansion Type: Locate anchors not more than 6 inches from top and bottom of frame. Space anchors not more than 26 inches o.c.

7. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

E. Hardware Preparation: Factory prepare hollow metal work to receive templated mortised hardware include cutouts, reinforcement, mortising, drilling and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
   1. Reinforce doors and frames to receive non-templated, mortised and surface-mounted door hardware.
   2. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on Shop Drawings or, if not indicated, according to ANSI A250.8.
3. Coordinate locations of conduit and wiring boxes for electrical connections.
4. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.

F. 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 door or frame.
   2. Multiple Glazed Lites: Provide fixed and removable stops and moldings such that each glazed lite is capable of being removed independently.
   3. Provide fixed frame moldings 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.

2.10 STEEL FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Finish hollow metal door and frames after assembly.

B. Metallic-Coated Steel Surface Preparation: Clean surfaces with non-petroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.

C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

D. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils.
   1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.

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 hollow metal doors and frames.
   1. Examine roughing-in for embedded and built-in anchors to verify actual locations of hollow metal frame connections before frame installation.
   2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory.

B. Prior to installation and with installation spreaders in place, adjust and securely brace hollow metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

1. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
2. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
3. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
4. Plumbness: Plus or minus 1/16 inch, measured at jambs on a perpendicular line from head to floor.

C. Drill and tap doors and frames to receive non-templated mortised and surface-mounted door hardware.

3.3 INSTALLATION

A. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install hollow metal doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer’s written instructions.

B. Hollow Metal Frames: Install standard hollow metal frames for doors, sidelights, borrowed lights, and other openings, of size and profiles indicated. 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 due to 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 plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
   g. Apply bituminous coating to backs of frames that are filled with mortar, grout and plaster containing anti-freezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
   a. Floor anchors may be set with powder-actuated fasteners instead of post-installed expansion anchors if so indicated and approved on Shop Drawings.


4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division $ Section “Unit Masonry Assemblies.”

5. Concrete Walls: Solidly fill space between frames and concrete with grout. Take precautions, including bracing frames, to ensure that frames are not deformed or damaged by grout forces.
6. **In-Place Concrete or Masonry Construction:** Secure frames in place with post-installed expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

7. **In-Place Gypsum Board Partitions:** Secure frames in place with post-installed expansion anchors through floor anchors at each jamb. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.

8. **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.

9. **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.

C. **Hollow Metal Doors:** Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

   1. **Non-Fire-Rated Hollow Metal Doors:**
      
      a. **Jambs and Head:** 1/8 inch plus or minus 1/16 inch.
      
b. **Between Edges of Pairs of Doors:** 1/8 inch plus or minus 1/16 inch.
      
c. **Between Bottom of Door and Top of Threshold:** Maximum 3/8 inch.
      
d. **Between Bottom of Door and Top of Finish Floor (No Threshold):** Maximum 3/4 inch.

   2. **Fire-Rated Doors:** Install doors with clearances according to NFPA 80.

   3. **Smoke-Control Doors:** Install doors according to NFPA 105.

D. **Glazing:** Comply with installation requirements in Division 8 Section "Glazing" and with hollow metal door and frame 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.

3.4 **ADJUSTING AND CLEANING**

A. **Final Adjustments:** Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal doors or frames that are 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
SECTION 08 1416 – FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Solid-core flush wood doors.
   2. Flush wood doors field installed in hollow metal frames.
   3. Factory finishing flush wood doors.
   4. Factory machining flush wood doors for hardware.

B. Related Sections include the following:
   1. Division 08 Section “Hollow Metal Doors & Frames” for wood doors installed in hollow metal frames.
   2. Division 08 Section “Glazing” for glass view panels and sidelites.
   3. Division 08 Section “Door Hardware” for door hardware for wood doors.

1.2 SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction, louvers, and trim for openings. Include factory-finishing specifications.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in Product Data; location and extent of hardware blocking; and other pertinent data, and the following:
   1. Indicate dimensions and locations of mortises and holes for hardware.
   2. Indicate dimensions and locations of cutouts, including doors with glazed openings.
   3. Undercuts.
   4. Requirements for veneer matching at doors with hardwood veneer.
   5. Doors to be factory finished and finish requirements.

C. Samples for Verification:
   1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer’s written instructions.

B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.
1.4 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form, signed by manufacturer, Installer, and Contractor, in which manufacturer agrees to repair or replace doors that are defective in materials or workmanship, have warped (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section, or show telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

1. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.
2. Warranty shall be in effect during the following period of time from date of Substantial Completion:

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

2. Kolbe Windows and Doors.
3. Algoma Hardwoods Inc.
4. Mohawk Flush Doors, Inc.
5. Approved equal.

2.2 DOOR CONSTRUCTION, GENERAL

A. Veneer: AWI custom quality wood, plain sliced with book matched hardwood veneer for transparent finish:
   1. Wood: Oak.

B. Particleboard Cores: Comply with the following requirements.

   1. Particleboard: ANSI A208.1, Grade LD-1.
   2. Blocking: Provide wood blocking in particleboard-core doors as needed to eliminate through-bolting hardware.
   3. Provide doors with structural composite lumber cores instead of particleboard cores at locations where exit devices are indicated.

C. Interior Solid-Core Doors:

   1. Grade: Custom.
   2. Core: Structural composite lumber.
3. Construction: Five plies with stiles and rails bonded to core, then entire unit is abrasive planed before veneering.

D. Mineral-Core Doors:
   1. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 LOUVERS AND LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors:
   1. Wood Species: Same species as door faces.
   2. Profile: Lipped tapered beads.

2.4 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:
   1. Comply with clearance requirements of referenced quality standard for fitting.

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, DHI A115-W series standards, and hardware templates.
   1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Openings: Cut and trim openings through doors to comply with applicable requirements of referenced standards for kind(s) of door(s) required.
   1. Light Openings: Trim openings with moldings of material and profile indicated.
   2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with applicable requirements in Division 08 Section "Glazing."

2.5 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
   1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Finish doors at factory.

C. Transparent Finish:
   1. Grade: Premium.
   2. Finish: AWI conversion varnish system.
3. Staining: VOC content not more than 250 g/L.
5. Sheen: Satin.
6. Color: As selected by Architect from manufacturer’s standard range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames before hanging doors.
   1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation see Division 08 “Door Hardware.”
   1. Hinges to be factory installed for prehung doors.

B. Manufacturer’s Written Instructions: Install doors to comply with manufacturer’s written instructions, referenced quality standard, and as indicated.

C. Pre-hung doors:
   1. Install pre-hung door units to operate freely, but not loosely, and free from rattling when in latched position. Doors shall be free from hinge bound conditions, sticking or binding with hardware properly adjusted and in functioning order.
   2. Jambs shall be set plumb. Jamb legs shall be set square with header and with each other within 1/16”.
   3. Securely seat jambs directly onto floor.
   4. Jambs shall be securely anchored with concealed fasteners where possible. Exposed fastening (nails or trim-head screws) shall be deep set and filled.
   5. Field joints shall be tightly fitted and flush.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or do not comply with requirements. Doors may be repaired or refinishing if work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION 08 1416
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior storefront framing and doors.

1.2 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:
   a. Deflection exceeding specified limits.
   b. Thermal stresses transferring to building structure.
   c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
   d. Noise or vibration created by wind and by thermal and structural movements.
   e. Loosening or weakening of fasteners, attachments, and other components.
   f. Failure of operating units.
   g. Sealant failure.

B. Wind Loads: As indicated on Drawings.

C. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch, whichever is smaller.

D. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at 150 percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding 0.2 percent of span.
2. Test Durations: 10 seconds.

E. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 1.57 lbf/sq. ft.
F. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.
   2. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

C. Samples: For each type of exposed finish required.

D. Maintenance data to include in maintenance manuals.

E. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.


C. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

1.5 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations and dimensions of structural supports for aluminum-framed systems by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating aluminum-framed systems without field measurements. Coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to structural failures, including, but not limited to excessive deflection; noise or vibration caused by thermal movements; deterioration of metals, metal finishes and other materials beyond normal weathering; water leakage through fixed glazing and framing areas; failure of operating components.
   1. Warranty Period: Five years from date of Substantial Completion.
B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Arch Aluminum & Glass Co., Inc.
2. CMI Architectural.
3. Commercial Architectural Products, Inc.
4. EFCO Corporation.
5. Kawneer North America; an Alcoa company.
6. TRACO.
7. Tubelite.
8. United States Aluminum.
10. Approved Equal.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING SYSTEMS

A. Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Exterior Framing: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: As indicated.
B. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

C. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce members as required to receive fastener threads.
   3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

D. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

E. Framing System Gaskets and Sealants: Manufacturer's standard, recommended by manufacturer for joint type.
   1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Division 08 Section "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

D. Bond-Breaker Tape: Manufacturer's standard TFE-fluorocarbon or polyethylene material to which sealants will not develop adhesion.

2.5 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.
   1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch-thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
      a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.
   2. Door Design: As indicated.
      a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.
      a. Provide non-removable glazing stops on outside of door.
2.6 ENTRANCE DOOR HARDWARE

A. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements in this Section.

1. Entrance Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and named manufacturers’ products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
3. Opening-Force Requirements:
   a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.

B. Opening-Force Requirements:

1. Latches and Exit Devices: Not more than 15 lbf required to release latch.

C. Weather Stripping: Manufacturer’s standard bulb-polymeric type.

D. Weather Sweeps: Manufacturer’s standard exterior-door bottom sweep with concealed fasteners on mounting strip.

E. Silencers: BHMA A 156.16, Grade 1.

F. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:3, with maximum height of 1/2 inch. Provide thermally broken thresholds for thermal entrances.

G. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

H. Operating Trim: BHMA A156.6.

I. Finger Guards: Manufacturer’s standard collapsible neoprene or PVC gasket anchored to frame hinge-jamb at center-pivoted doors.

J. Additional hardware specified in Division 08, Section "Door Hardware."

2.7 SEALANTS

A. Glazing Sealants: As recommended by manufacturer for joint type, and as follows:

1. Weatherseal Sealant: ASTM C 920 for Type S, Grade NS, Class 25, Uses NT, G, A, and O; single-component neutral-curing formulation that is compatible with structural sealant and other system components with which it comes in contact; recommended by structural-sealant, weatherseal-sealant, and aluminum-framed system manufacturer for this use.

B. Structural Sealant: ASTM C 1184, single-component neutral-curing silicone formulation that is compatible with system components with which it comes in contact, specifically formulated and tested for use as structural sealant and approved by a structural sealant manufacturer for use in aluminum-framed systems indicated.

C. Provide sealants for use inside of the weatherproofing system that have a VOC content of 100 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Color: As selected by Architect from manufacturer’s full range.
2.8 ACCESSORY MATERIALS

A. Brackets and Reinforcements: Manufacturer’s standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

B. Fasteners and Accessories: Manufacturer’s standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.
   1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
   2. Reinforce aluminum members less than 0.125 inch thick to receive fastener threads or provide standard non-corrosive pressed-in splined grommet nuts.
   3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system.

C. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts, complying with ASTM A 123/A 123M or ASTM A 153/A 153M.

D. Concealed Flashing: Manufacturer’s standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials, which do not bridge thermal breaks.

E. Framing System Gaskets and Sealants: Manufacturer’s standard, recommended by manufacturer for joint type.
   1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 260 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Air Baffles: Reticulated polymer filter foam with 30 pores per inch.

G. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil thickness per coat.

2.9 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Framing Members, General: Fabricate components that, when assembled, have the following characteristics:
   1. Profiles that are sharp, straight, and free of defects or deformations.
   2. Accurately fitted joints with ends coped or mitered.
   3. Means to drain water passing joints, condensation within framing members, and moisture migrating within the system to exterior.
   4. Physical and thermal isolation of glazing from framing members.
   5. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
   7. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
F. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
   1. At pairs of exterior doors, provide sliding weather stripping retained in adjustable strip mortised into door edge.
   2. At exterior doors, provide weather sweeps applied to door bottoms.

G. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

H. Trim, Closures and Fillers: Fabricate to fit tightly to adjoining construction, with weather tight joints at exterior installations, in maximum lengths to minimize joints. Product flat, flush surfaces without cracking or grain separation at bends. Fold back exposed edges of unsupported sheet metal to form a 1/2-inch-wide hem on the concealed side, or ease edges to a radius of approximately 1/32 inch and support with concealed stiffeners.
   1. Support joints with concealed stiffeners as needed to hold exposed faces of adjoining sheets in flush alignment.
   2. Build in straps, plates, and brackets as needed to support and anchor fabrications.
   3. Partition Closures: Form closures at partition-mullion abutments from two aluminum sheets, separated by channels of the same material to produce a panel of same thickness as partitions. Incorporate reveals, trim, and concealed anchorages for attaching to adjacent surfaces.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.10 ENTRANCE DOOR HARDWARE SETS

   A. See Section 08 7100.

2.11 ALUMINUM FINISHES

   A. General: Comply with NAAMM’s “Metal Finishes Manual for Architectural and Metal Products” for recommendations for applying and designating finishes.

   B. Clear Anodic Finish: AAMA 611, AA-M12C22A1, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

   A. Examine openings, substrates, structural support, anchorage, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work. Verify rough opening dimensions, levelness of sill plate and operational clearances. Examine wall flashings, vapor retarders, water and weather barriers, and other built-in components to ensure a coordinated, weather tight sliding door installation.

   1. Masonry Surfaces: Visibly dry and free or excess mortar, sand, and other construction debris.
   2. Wood Frame Walls: Dry, clean, sound, well nailed, free of voids, and without offsets at joints. Ensure that nail heads are driven flush with surfaces in opening and within 3 inches of opening.
   3. Metal Surfaces: Dry; clean; free of grease, soil, dirt, rust, corrosion, and welding slag; without sharp edges or offsets at joints.
   4. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION

A. General:

1. Comply with manufacturer’s written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Division 7 Section "Joint Sealants" to produce weather tight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Division 8 Section "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weather tight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers’ written instructions using concealed fasteners to greatest extent possible.

H. Erection Tolerances: Install aluminum-framed systems to comply with the following maximum tolerances:

1. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/4 inch over total length.
2. Alignment:
   a. Where surfaces abut in line, limit offset from true alignment to 1/16 inch.
   b. Where surfaces meet at corners, limit offset from true alignment to 1/32 inch.
3. Diagonal Measurements: Limit difference between diagonal measurement to 1/8 inch.

I. Adjust operating hardware for smooth operation according to hardware manufacturer’s written instructions.

1. For doors accessible to people with disabilities, adjust closers to provide a 3-second closer sweep period for doors to move from a 70-degree open position to 3 inches from the latch measured to the leading door edge.
3.3 ADJUSTING, CLEANING, AND PROTECTION

A. Clean aluminum surfaces immediately after installing aluminum-framed storefront. Avoid damaging protective coatings and finishes. Remove excess sealants, glazing materials, dirt, and other substances.

B. Clean glass immediately after installation. Comply with glass manufacturer’s written recommendations for final cleaning and maintenance. Remove nonpermanent labels, and clean surfaces.

C. Remove and replace glass that has been broken, chipped, cracked, abraded, or damaged during construction period.

D. Touch-up minor damage to factory applied finish; where damage has occurred in readily seen areas, replace damaged components. Finishes and surfaces that cannot be satisfactorily repaired or touched up to the Architect’s and Owner’s approval shall be replaced in-kind.

E. Protect finished work from damage for the duration of the construction period or until acceptance by the Owner.

3.4 ENTRANCE DOOR HARDWARE SETS

A. See Division 08, Section "Door Hardware."

END OF SECTION 08 4113
PART 1 - GENERAL

1.01 SUMMARY

A. Section includes:

1. Mechanical and electrified door hardware for:
   a. Swinging doors.

2. Electronic access control system components, including:
   a. Electronic access control devices.

3. Key lock box for fire department access.

4. The intent of the hardware specification is to specify the hardware for interior and exterior doors, and to establish a type, continuity, and standard of quality. However, it is the door hardware supplier’s responsibility to thoroughly review existing conditions, schedules, specifications, drawings, and other Contract Documents to verify the suitability of the hardware specified.

B. Exclusions: Unless specifically listed in hardware sets, hardware is not specified in this section for:

   1. Windows
   2. Cabinets (casework), including locks in cabinets
   3. Signage
   4. Toilet accessories
   5. Overhead doors

C. Related Sections:

   1. Division 07 Section “Joint Sealants” for sealant requirements applicable to threshold installation specified in this section.
   2. Division 08 Sections for preparing doors and frames for the products specified in this section.
   3. Division 26 sections for connections to electrical power system and for low-voltage wiring.
   4. Division 28 sections for coordination with other components of electronic access control system.

1.02 REFERENCES

A. UL - Underwriters Laboratories

   1. UL 10B - Fire Test of Door Assemblies
   2. UL 10C - Positive Pressure Test of Fire Door Assemblies
   3. UL 1784 - Air Leakage Tests of Door Assemblies
   4. UL 305 - Panic Hardware

B. DHI - Door and Hardware Institute
1. Sequence and Format for the Hardware Schedule
2. Recommended Locations for Builders Hardware
3. Key Systems and Nomenclature

C. ANSI - American National Standards Institute

   1. ANSI/BHMA A156.1 - A156.29, and ANSI/BHMA A156.31 - Standards for Hardware and Specialties

1.03 SUBMITTALS

A. General:

   1. Submit in accordance with Conditions of Contract and Division 01 requirements.
   2. Highlight, encircle, or otherwise specifically identify on submittals deviations from Contract Documents, issues of incompatibility or other issues which may detrimentally affect the Work.
   3. Prior to forwarding submittal, comply with procedures for verifying existing door and frame compatibility for new hardware, as specified in PART 3, “EXAMINATION” article, herein.

B. Action Submittals:

   1. Product Data: Technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
   2. Riser and Wiring Diagrams: After final approval of hardware schedule, submit details of electrified door hardware, indicating:

      a. Wiring Diagrams: For power, signal, and control wiring and including:
         1) Details of interface of electrified door hardware and building safety and security systems.
         2) Schematic diagram of systems that interface with electrified door hardware.
         3) Point-to-point wiring.
         4) Risers.

   3. Samples for Verification: If requested by Architect, submit production sample or sample installations of each type of exposed hardware unit in finish indicated, and tagged with full description for coordination with schedule.

      a. Samples will be returned to supplier. Units that are acceptable to Architect may, after final check of operations, be incorporated into Work, within limitations of key coordination requirements.

   4. Door Hardware Schedule: Submit schedule with hardware sets in vertical format as illustrated by Sequence of Format for the Hardware Schedule as published by the Door and Hardware Institute. Indicate complete designations of each item required for each door or opening, include:

      a. Door Index; include door number, heading number, and Architect's hardware set number.
      b. Opening Lock Function Spreadsheet: List locking device and function for each opening.
      c. Quantity, type, style, function, size, and finish of each hardware item.
      d. Name and manufacturer of each item.
      e. Fastenings and other pertinent information.
      f. Location of each hardware set cross-referenced to indications on Drawings.
      g. Explanation of all abbreviations, symbols, and codes contained in schedule.
      h. Mounting locations for hardware.
      i. Door and frame sizes and materials.
      j. Name and phone number for local manufacturer's representative for each product.
      k. Operational Description of openings with any electrified hardware (locks, exits, electromagnetic locks, electric strikes, automatic operators, door position switches, magnetic holders or closer/holder units, and
access control components). Operational description should include operational descriptions for: egress, ingress (access), and fire/smoke alarm connections.

1) Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate fabrication of other work that is critical in Project construction schedule.

5. Key Schedule:
   a. After Keying Conference, provide keying schedule listing levels of keying as well as explanation of key system’s function, key symbols used and door numbers controlled.
   b. Use ANSI/BHMA A156.28 “Recommended Practices for Keying Systems” as guideline for nomenclature, definitions, and approach for selecting optimal keying system.
   c. Provide 3 copies of keying schedule for review prepared and detailed in accordance with referenced DHI publication. Include schematic keying diagram and index each key to unique door designations.
   d. Index keying schedule by door number, keyset, hardware heading number, cross keying instructions, and special key stamping instructions.
   e. Provide one complete bitting list of key cuts and one key system schematic illustrating system usage and expansion.
      1) Forward bitting list, key cuts and key system schematic directly to Owner, by means as directed by Owner.
   f. Prepare key schedule by or under supervision of supplier, detailing Owner’s final keying instructions for locks.

6. Templates: After final approval of hardware schedule, provide templates for doors, frames and other work specified to be factory or shop prepared for door hardware installation.

C. Informational Submittals:

1. Qualification Data: For Supplier, Installer and Architectural Hardware Consultant.
2. Product data for electrified door hardware:
   a. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.
3. Certificates of Compliance:
   a. UL listings for fire-rated hardware and installation instructions if requested by Architect or Authority Having Jurisdiction.
   b. Installer Training Meeting Certification: Letter of compliance, signed by Contractor, attesting to completion of installer training meeting specified in “QUALITY ASSURANCE” article, herein.
   c. Electrified Hardware Coordination Conference Certification: Letter of compliance, signed by Contractor, attesting to completion of electrified hardware coordination conference, specified in “QUALITY ASSURANCE” article, herein.

4. Warranty: Special warranty specified in this Section.

D. Closeout Submittals:

1. Operations and Maintenance Data: Provide in accordance with Division 01 and include:
   a. Complete information on care, maintenance, and adjustment; data on repair and replacement parts, and information on preservation of finishes.
   b. Catalog pages for each product.
c. Factory order acknowledgement numbers (for warranty and service)
d. Name, address, and phone number of local representative for each manufacturer.
e. Parts list for each product.
f. Final approved hardware schedule, edited to reflect conditions as-installed.
g. Final keying schedule
h. Copies of floor plans with keying nomenclature
i. As-installed wiring diagrams for each opening connected to power, both low voltage and 110 volts.
j. Copy of warranties including appropriate reference numbers for manufacturers to identify project.

1.04 QUALITY ASSURANCE

A. Supplier Qualifications and Responsibilities: Recognized architectural hardware supplier with record of successful in-service performance for supplying door hardware similar in quantity, type, and quality to that indicated for this Project and that provides certified Architectural Hardware Consultant (AHC) available to Owner, Architect, and Contractor, at reasonable times during the Work for consultation.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.
4. Coordination Responsibility: Assist in coordinating installation of electronic security hardware with Architect and electrical engineers and provide installation and technical data to Architect and other related subcontractors.
   a. Upon completion of electronic security hardware installation, inspect and verify that all components are working properly.

B. Architectural Hardware Consultant Qualifications: Person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and meets these requirements:

1. For door hardware, DHI-certified, Architectural Hardware Consultant (AHC).
2. Can provide installation and technical data to Architect and other related subcontractors.
3. Can inspect and verify components are in working order upon completion of installation.
5. Capable of coordinating installation of electrified hardware with Architect and electrical engineers.

C. Single Source Responsibility: Obtain each type of door hardware from single manufacturer.

D. Fire-Rated Door Openings: Provide door hardware for fire-rated openings that complies with NFPA 80 and requirements of authorities having jurisdiction. Provide only items of door hardware that are listed products tested by Underwriters Laboratories, Intertek Testing Services, or other testing and inspecting organizations acceptable to authorities having jurisdiction for use on types and sizes of doors indicated, based on testing at positive pressure and according to NFPA 252 or UL 10C and in compliance with requirements of fire-rated door and door frame labels.

E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by testing agency acceptable to authorities having jurisdiction.

F. Accessibility Requirements: For door hardware on doors in an accessible route, comply with governing accessibility regulations cited in "REFERENCES" article, herein.
G. Keying Conference

1. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including:
   a. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
   b. Preliminary key system schematic diagram.
   c. Requirements for key control system.
   d. Requirements for access control.
   e. Address for delivery of keys.

H. Pre-installation Conference

1. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
2. Inspect and discuss preparatory work performed by other trades.
3. Inspect and discuss electrical roughing-in for electrified door hardware.
4. Review sequence of operation for each type of electrified door hardware.
5. Review required testing, inspecting, and certifying procedures.

I. Coordination Conferences:

1. Installation Coordination Conference: Prior to hardware installation, schedule and hold meeting to review questions or concerns related to proper installation and adjustment of door hardware.
2. Electrified Hardware Coordination Conference: Prior to ordering electrified hardware, schedule and hold meeting to coordinate door hardware with security, electrical, doors and frames, and other related suppliers.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

1. Deliver each article of hardware in manufacturer's original packaging.

C. Project Conditions:

1. Maintain manufacturer-recommended environmental conditions throughout storage and installation periods.
2. Provide secure lock-up for door hardware delivered to Project. Control handling and installation of hardware items so that completion of Work will not be delayed by hardware losses both before and after installation.

D. Protection and Damage:

1. Promptly replace products damaged during shipping.
2. Handle hardware in manner to avoid damage, marring, or scratching. Correct, replace or repair products damaged during Work.
3. Protect products against malfunction due to paint, solvent, cleanser, or any chemical agent.

E. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

F. Deliver keys to Owner by registered mail or overnight package service.
1.06 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory or shop prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner’s security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.07 WARRANTY

A. Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Beginning from date of Substantial Completion, for durations indicated.
   a. Closers:
      1) Mechanical: LCN 4000 series, 30 years
   b. Locksets:
      1) Mechanical: Schlage ND series, 10 years
   c. Continuous Hinges: Lifetime warranty.
   d. Key Blanks: Lifetime

2. Warranty does not cover damage or faulty operation due to improper installation, improper use or abuse.

1.08 MAINTENANCE

A. Maintenance Tools: Furnish complete set of special tools required for maintenance and adjustment of hardware, including changing of cylinders.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Approval of manufacturers and/or products other than those listed as “Scheduled Manufacturer” or “Acceptable Manufacturers” in the individual article for the product category shall be in accordance with QUALITY ASSURANCE article, herein.

B. Approval of products from manufacturers indicated in “Acceptable Manufacturers” is contingent upon those products providing all functions and features and meeting all requirements of scheduled manufacturer’s product.

C. Where specified hardware is not adaptable to finished shape or size of members requiring hardware, furnish suitable types having same operation and quality as type specified, subject to Architect’s approval.
2.02 MATERIALS

A. Fasteners

1. Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation.
2. Furnish screws for installation with each hardware item. Finish exposed (exposed under any condition) screws to match hardware finish, or, if exposed in surfaces of other work, to match finish of this other work including prepared for paint surfaces to receive painted finish.
3. Provide concealed fasteners for hardware units exposed when door is closed except when no standard units of type specified are available with concealed fasteners. Do not use thru-bolts for installation where bolt head or nut on opposite face is exposed in other work unless thru-bolts are required to fasten hardware securely. Review door specification and advise Architect if thru-bolts are required.
4. Install hardware with fasteners provided by hardware manufacturer.

B. Provide screws, bolts, expansion shields, drop plates and other devices necessary for hardware installation.

1. Where fasteners are exposed to view: Finish to match adjacent door hardware material.

2.03 HINGES

A. Manufacturers and Products:


B. Requirements:

1. Provide hinges conforming to ANSI/BHMA A156.1.
2. 1-3/4 inch (44 mm) thick doors, up to and including 36 inches (914 mm) wide:
   a. Exterior: Standard weight, bronze or stainless steel, 4-1/2 inches (114 mm) high
   b. Interior: Standard weight, steel, 4-1/2 inches (114 mm) high
3. 1-3/4 inch (44 mm) thick doors over 36 inches (914 mm) wide:
   a. Exterior: Heavy weight, bronze/stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high
4. 2 inches or thicker doors:
   a. Exterior: Heavy weight, bronze or stainless steel, 5 inches (127 mm) high
   b. Interior: Heavy weight, steel, 5 inches (127 mm) high
5. Provide three hinges per door leaf for doors 90 inches (2286 mm) or less in height, and one additional hinge for each 30 inches (762 mm) of additional door height.
6. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
   a. Steel Hinges: Steel pins
   b. Non-Ferrous Hinges: Stainless steel pins
   c. Out-Swinging Exterior Doors: Non-removable pins
   d. Out-Swinging Interior Lockable Doors: Non-removable pins
   e. Interior Non-lockable Doors: Non-rising pins
7. Width of hinges: 4-1/2 inches (114 mm) at 1-3/4 inch (44 mm) thick doors, and 5 inches (127 mm) at 2 inches (51 mm) or thicker doors. Adjust hinge width as required for door, frame, and wall conditions to allow proper degree of opening.
8. Provide mortar guard for each electrified hinge specified.

2.04 CONTINUOUS HINGES

A. Aluminum Geared

1. Manufacturers:
   a. Scheduled Manufacturer: Ives.

2. Requirements:
   a. Provide aluminum geared continuous hinges conforming to ANSI/BHMA A156.26, Grade 1.
   b. Provide aluminum geared continuous hinges, where specified in the hardware sets, fabricated from 6063-T6 aluminum.
   c. Provide split nylon bearings at each hinge knuckle for quiet, smooth, self-lubricating operation.
   d. Provide hinges capable of supporting door weights up to 450 pounds, and successfully tested for 1,500,000 cycles.
   e. On fire-rated doors, provide aluminum geared continuous hinges that are classified for use on rated doors by testing agency acceptable to authority having jurisdiction.
   f. Install hinges with fasteners supplied by manufacturer.
   g. Provide hinges 1 inch (25 mm) shorter in length than nominal height of door, unless otherwise noted or door details require shorter length and with symmetrical hole pattern.

2.05 CYLINDRICAL LOCKS – GRADE 1

A. Manufacturers and Products:


B. Requirements:

1. Provide cylindrical locks conforming to ANSI/BHMA A156.2 Series 4000, Grade 1, and UL Listed for 3 hour fire doors.
2. Cylinders: Refer to “KEYING” article, herein.
3. Provide locks with standard 2-3/4 inches (70 mm) backset, unless noted otherwise, with 1/2 inch latch throw. Provide proper latch throw for UL listing at pairs.
4. Provide locksets with separate anti-rotation thru-bolts, and no exposed screws.
5. Provide independently operating levers with two external return spring cassettes mounted under roses to prevent lever sag.
6. Provide standard ASA strikes unless extended lip strikes are necessary to protect trim.
7. Provide electrified options as scheduled in the hardware sets.
8. Lever Trim: Solid cast levers without plastic inserts and wrought roses on both sides.

2.06 ELECTRIC STRIKES

A. Manufacturers and Products:
   1. Scheduled Manufacturer and Product: Von Duprin 6000 Series.

B. Requirements:
   1. Provide electric strikes designed for use with type of locks shown at each opening.
   2. Provide electric strikes UL Listed as burglary-resistant.
   3. Where required, provide electric strikes UL Listed for fire doors and frames.
   4. Provide transformers and rectifiers for each strike as required. Verify voltage with electrical contractor.

2.07 CYLINDERS

A. Manufacturers:
   1. Scheduled Manufacturer: Field verify existing keyway/cylinder prior to bidding. Match and integrate into existing key system.

B. Requirements:
   1. Provide permanent and interchangeable cylinders/cores to match Owner’s existing key system, compliant with ANSI/BHMA A156.5; latest revision; cylinder face finished to match lockset, manufacturer’s series as indicated. Refer to “KEYING” article, herein.

C. Construction Keying:
   1. Replaceable Construction Cores.
      a. Provide temporary construction cores replaceable by permanent cores, furnished in accordance with the following requirements.
         1) 3 construction control keys
         2) 12 construction change (day) keys.
      b. Owner or Owner’s Representative will replace temporary construction cores with permanent cores.

2.08 KEYING

A. Provide cylinders/cores keyed into Owner’s existing keying system, complying with guidelines in ANSI/BHMA A156.28, incorporating decisions made at keying conference.

B. Requirements:
   1. Provide permanent cylinders/cores keyed by the manufacturer according to the following key system.
      a. Master Keying system as directed by the Owner.
   2. Forward bitting list and keys separately from cylinders, by means as directed by Owner. Failure to comply with forwarding requirements will be cause for replacement of cylinders/cores involved at no additional cost to Owner.
   3. Provide keys with the following features:
a. Material: Nickel silver; minimum thickness of .107-inch (2.3mm)
b. Patent Protection: Keys and blanks protected by one or more utility patent(s) until the year, 2029.

4. Identification:
   a. Mark permanent cylinders/cores and keys with applicable blind code per DHI publication "Keying Systems and Nomenclature" for identification. Do not provide blind code marks with actual key cuts.
   b. Identification stamping provisions must be approved by the Architect and Owner.
   c. Stamp cylinders/cores and keys with Owner's unique key system facility code as established by the manufacturer; key symbol and embossed or stamped with "DO NOT DUPLICATE" along with the "PATENTED" or patent number to enforce the patent protection.
   d. Failure to comply with stamping requirements will be cause for replacement of keys involved at no additional cost to Owner.
   e. Forward permanent cylinders/cores to Owner, separately from keys, by means as directed by Owner.

5. Quantity: Furnish in the following quantities.
   a. Change (Day) Keys: 3 per cylinder/core.
   b. Permanent Control Keys: 3.

2.09 KEY CONTROL SYSTEM

A. Manufacturers:
   1. Scheduled Manufacturer: Telkee.

B. Requirements:
   1. Provide key control system, including envelopes, labels, tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet, all as recommended by system manufacturer, with capacity for 150% of number of locks required for Project.
      a. Provide complete cross index system set up by hardware supplier, and place keys on markers and hooks in cabinet as determined by final key schedule.
      b. Provide hinged-panel type cabinet for wall mounting.

2.10 DOOR CLOSERS

A. Manufacturers and Products:

B. Requirements:
   1. Provide door closers conforming to ANSI/BHMA A156.4 Grade 1 requirements by BHMA certified independent testing laboratory. ISO 9000 certify closers. Stamp units with date of manufacture code.
   2. Provide door closers with fully hydraulic, full rack and pinion action with high strength cast iron cylinder, and full complement bearings at shaft.
3. Cylinder Body: 1-1/2 inch (38 mm) diameter with 3/4 inch (19 mm) diameter double heat-treated pinion journal.
4. Hydraulic Fluid: Fireproof, passing requirements of UL10C, and requiring no seasonal closer adjustment for temperatures ranging from 120 degrees F to -30 degrees F.
5. Spring Power: Continuously adjustable over full range of closer sizes, and providing reduced opening force as required by accessibility codes and standards.
6. Hydraulic Regulation: By tamper-proof, non-critical valves, with separate adjustment for latch speed, general speed, and backcheck.
7. Provide closers with solid forged steel main arms and factory assembled heavy-duty forged forearms for parallel arm closers.
8. Pressure Relief Valve (PRV) Technology: Not permitted.
9. Finish for Closer Cylinders, Arms, Adapter Plates, and Metal Covers: Powder coating finish which has been certified to exceed 100 hours salt spray testing as described in ANSI Standard A156.4 and ASTM B117, or has special rust inhibitor (SRI).
10. Provide special templates, drop plates, mounting brackets, or adapters for arms as required for details, overhead stops, and other door hardware items interfering with closer mounting.

2.11 DOOR TRIM

A. Manufacturers:
   1. Scheduled Manufacturer: Ives.

B. Requirements:
   1. Provide push plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick and beveled 4 edges. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
   2. Provide push bars of solid bar stock, diameter and length as scheduled. Provide push bars of sufficient length to span from center to center of each stile. Where required, mount back to back with pull.
   3. Provide offset pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
   4. Provide flush pulls as scheduled. Where required, provide back-to-back mounted model.
   5. Provide pulls of solid bar stock, diameter and length as scheduled. Where required, mount back to back with push bar.
   6. Provide pull plates 4 inches (102 mm) wide by 16 inches (406 mm) high by 0.050 inch (1 mm) thick, beveled 4 edges, and prepped for pull. Where width of door stile prevents use of 4 inches (102 mm) wide plate, adjust width to fit.
   7. Provide wire pulls of solid bar stock, diameter and length as scheduled.
   8. Provide decorative pulls as scheduled. Where required, mount back to back with pull.

2.12 PROTECTION PLATES

A. Manufacturers:
   1. Scheduled Manufacturer: Ives.

B. Requirements:
   1. Provide kick plates, mop plates, and armor plates minimum of 0.050 inch (1 mm) thick, beveled four edges as scheduled. Furnish with sheet metal or wood screws, finished to match plates.
2. Sizes of plates:
   a. Kick Plates: 10 inches (254 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
   b. Mop Plates: 4 inches (102 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs
   c. Armor Plates: 36 inches (914 mm) high by 2 inches (51 mm) less width of door on single doors, 1 inch (25 mm) less width of door on pairs

2.13 OVERHEAD STOPS AND OVERHEAD STOP/HOLDERS
A. Manufacturers:
   1. Scheduled Manufacturers: Glynn-Johnson.
B. Requirements:
   1. Provide heavy duty concealed mounted overhead stop or holder as specified for exterior and interior vestibule single acting doors.
   2. Provide heavy duty concealed mounted overhead stop or holder as specified for double acting doors.
   3. Provide heavy or medium duty and concealed or surface mounted overhead stop or holder for interior doors as specified. Provide medium duty surface mounted overhead stop for interior doors and at any door that swings more than 140 degrees before striking wall, open against equipment, casework, sidelights, and where conditions do not allow wall stop or floor stop presents tripping hazard.
   4. Where overhead holders are specified provide friction type at doors without closer and positive type at doors with closer.

2.14 DOOR STOPS AND HOLDERS
A. Manufacturers:
   1. Scheduled Manufacturer: Ives.
B. Provide door stops at each door leaf:
   1. Provide wall stops wherever possible. Provide convex type where mortise type locks are used and concave type where cylindrical type locks are used.
   2. Where a wall stop cannot be used, provide universal floor stops for low or high rise options.
   3. Where wall or floor stop cannot be used, provide medium duty surface mounted overhead stop.

2.15 THRESHOLDS, SEALS, DOOR SWEEPS, AUTOMATIC DOOR BOTTOMS, AND GASKETING
A. Manufacturers:
B. Requirements:
1. Provide thresholds, weather-stripping (including door sweeps, seals, and astragals) and gasketing systems (including smoke, sound, and light) as specified and per architectural details. Match finish of other items.
2. Smoke- and Draft-Control Door Assemblies: Where smoke- and draft-control door assemblies are required, provide door hardware that meets requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.
3. Size of thresholds:
   a. Saddle Thresholds: 1/2 inch (13 mm) high by jamb width by door width
   b. Bumper Seal Thresholds: 1/2 inch (13 mm) high by 5 inches (127 mm) wide by door width
4. Provide door sweeps, seals, astragals, and auto door bottoms only of type where resilient or flexible seal strip is easily replaceable and readily available.

2.16 DOOR POSITION SWITCHES

A. Manufacturers:
   1. Scheduled Manufacturer: Schlage.

B. Requirements:
   1. Provide recessed or surface mounted type door position switches as specified.
   2. Coordinate door and frame preparations with door and frame suppliers. If switches are being used with magnetic locking device, provide minimum of 4 inches (102 mm) between switch and magnetic locking device.

2.17 FINISHES

A. Finish: BHMA 626/652 (US26D); except:
   1. Hinges at Exterior Doors: BHMA 630 (US32D)
   2. Continuous Hinges: BHMA 630 (US32D)
   3. Continuous Hinges: BHMA 628 (US28)
   5. Protection Plates: BHMA 630 (US32D)
   6. Overhead Stops and Holders: BHMA 630 (US32D)
   7. Door Closers: Powder Coat to Match
   8. Wall Stops: BHMA 630 (US32D)
   9. Latch Protectors: BHMA 630 (US32D)
   10. Weatherstripping: Clear Anodized Aluminum
   11. Thresholds: Mill Finish Aluminum

2.18 KNOX BOX:

A. 3200 series secure key box with recessed mounting kit. Coordinate requirements with local fire department.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Prior to installation of hardware, examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Mount door hardware units at heights to comply with the following, unless otherwise indicated or required to comply with governing regulations.

2. Custom Steel Doors and Frames: HMMA 831.

B. Install each hardware item in compliance with manufacturer’s instructions and recommendations, using only fasteners provided by manufacturer.

C. Do not install surface mounted items until finishes have been completed on substrate. Protect all installed hardware during painting.

D. Set units level, plumb and true to line and location. Adjust and reinforce attachment substrate as necessary for proper installation and operation.

E. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

F. Install operating parts so they move freely and smoothly without binding, sticking, or excessive clearance.

G. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than quantity recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

H. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as indicated in keying section.

I. Wiring: Coordinate with Division 26, ELECTRICAL sections for:

1. Conduit, junction boxes and wire pulls.
2. Connections to and from power supplies to electrified hardware.
3. Connections to fire/smoke alarm system and smoke evacuation system.
4. Connection of wire to door position switches and wire runs to central room or area, as directed by Architect.
5. Testing and labeling wires with Architect’s opening number.
J. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

K. Door Closers: Mount closers on room side of corridor doors, inside of exterior doors, and stair side of stairway doors from corridors. Mount closers so they are not visible in corridors, lobbies and other public spaces unless approved by Architect.

L. Closer/ Holders: Mount closer/holders on room side of corridor doors, inside of exterior doors, and stair side of stairway doors.

M. Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings or in equipment room, or alternate location as directed by Architect.

N. Thresholds: Set thresholds in full bed of sealant complying with requirements specified in Division 07 Section "Joint Sealants."

O. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they may impede traffic or present tripping hazard.

P. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

Q. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

R. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.03 FIELD QUALITY CONTROL

A. Engage qualified manufacturer trained representative to perform inspections and to prepare inspection reports.

1. Representative will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.04 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
2. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately three to six months after date of Substantial Completion, Installer’s Architectural Hardware Consultant must examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors and door hardware.

3.05 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.
B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Substantial Completion.

3.06 DOOR HARDWARE SCHEDULE

A. Hardware items are referenced in the following hardware. Refer to the above-specifications for special features, options, cylinders/keying, and other requirements.

B. Hardware Sets:

HARDWARE GROUP NO. 1
For use on Door #(#s):

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>DOOR CONTACT</td>
<td>674-628</td>
<td></td>
<td>SCE</td>
</tr>
</tbody>
</table>

OPERATIONAL DESCRIPTION: DOOR STATUS (OPEN/CLOSED) IS MONITORED.

HARDWARE GROUP NO. 2
For use on Door #(#s):

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PASSAGE SET</td>
<td>ND10S RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP CUSH</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>488SBK PSA</td>
<td>BK</td>
<td>ZER</td>
</tr>
</tbody>
</table>

HARDWARE GROUP NO. 3
For use on Door #(#s):

<table>
<thead>
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<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PASSAGE SET</td>
<td>ND10S RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>
### HARDWARE GROUP NO. 4
For use on Door #(s):
101B
Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
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<tr>
<td>1</td>
<td>PASSAGE SET</td>
<td>ND10S RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. 5
For use on Door #(s):
103  104  105  108
Provide each SGL door(s) with the following:

<table>
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<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>ENTRANCE/OFFICE LOCK</td>
<td>ND50PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
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</table>

### HARDWARE GROUP NO. 6
For use on Door #(s):
107C
Provide each SGL door(s) with the following:

<table>
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<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PASSAGE SET</td>
<td>ND10S RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>488SBK PSA</td>
<td>BK</td>
<td>ZER</td>
</tr>
</tbody>
</table>

### HARDWARE GROUP NO. 7
For use on Door #(s):
112
Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PASSAGE SET</td>
<td>ND10S RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>488SBK PSA</td>
<td>BK</td>
<td>ZER</td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. 8
For use on Door #107B

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5 NRP</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>ELECTRIC STRIKE</td>
<td>6211 FSE DSLC CON 12/16/24/28 VAC/VDC</td>
<td>630</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>MULTITECH READER</td>
<td>CARD READER FURNISHED, COMMISSIONED AND INSTALLED BY DIV. 28</td>
<td>BLK</td>
<td>SCE</td>
</tr>
<tr>
<td>1</td>
<td>DESK MOUNT BUTTON</td>
<td>660-PB</td>
<td>628</td>
<td>SCE</td>
</tr>
<tr>
<td>1</td>
<td>DOOR CONTACT</td>
<td>679-05HM</td>
<td>BLK</td>
<td>SCE</td>
</tr>
<tr>
<td>1</td>
<td>PROVIDE FACTORY POINT TO POINT WIRING DIAGRAMS REQUIRED</td>
<td>CON (VERIFY LENGTH AND QUANTITY REQUIRED)</td>
<td>SCH</td>
<td></td>
</tr>
</tbody>
</table>

FIELD VERIFY EXISTING KEYWAY/MATCH AND INTEGRATE INTO EXISTING KEY SYSTEM.

OPERATIONAL DESCRIPTION: CREDENTIAL READER DEVICE IS TO RELEASE THE ELECTRIC STRIKE ALLOWING THE DOOR TO BE OPENED. KEYED INGRESS IS ALSO AVAILABLE. REMOTE RELEASE FROM RECEPTION DESK IS ALSO AVAILABLE. IMMEDIATE EGRESS IS ALWAYS AVAILABLE. DOOR STATUS (OPEN/CLOSED) IS MONITORED.

ITEMS TO BE PROVIDED BY THE DIVISION 28 SUPPLIER:
CREDENTIAL READER DEVICE.
REQUIRED POWER AND WIRING TO THE CREDENTIAL READER DEVICE, REMOTE RELEASE PUSH BUTTON, ELECTRIC STRIKE AND THE DOOR POSITION SWITCH.
HARDWARE GROUP NO. 9
For use on Door # (s):

113B 113C 113T 115A 115B

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>CONT. HINGE</td>
<td>224XY</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>CLASSROOM LOCK</td>
<td>ND70PD RHO</td>
<td>626</td>
<td>SCH</td>
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<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP SCUSH</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>RAIN DRIP</td>
<td>142AA</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>429AA-S</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>328AA-S</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>A</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>566A-V3-223</td>
<td>A</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR CONTACT</td>
<td>679-05HM</td>
<td>BLK</td>
<td>SCE</td>
</tr>
</tbody>
</table>

FIELD VERIFY EXISTING KEYWAY/MATCH AND INTEGRATE INTO EXISTING KEY SYSTEM.
MOUNT 429A HEAD SEAL PRIOR TO MOUNTING CLOSER. 328AA IS TO BE USED AS JAMB SEALS.

OPERATIONAL DESCRIPTION: DOOR STATUS (OPEN/CLOSED) IS MONITORED.
HARDWARE GROUP NO. 10
For use on Door #(s):
113A

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>CONT. HINGE</td>
<td>224XY</td>
<td>628</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>ELECTRIC STRIKE</td>
<td>6211 FSE DSLC CON 12/16/24/28 VAC/VDC</td>
<td>630</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP SCUSH</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>328AA-S</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>GASKETING</td>
<td>429AA-S</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>RAIN DRIP</td>
<td>142AA</td>
<td>AA</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>DOOR SWEEP</td>
<td>39A</td>
<td>A</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>THRESHOLD</td>
<td>566A-V3-223</td>
<td>A</td>
<td>ZER</td>
</tr>
<tr>
<td>1</td>
<td>MULTITECH READER</td>
<td>CARD READER FURNISHED, COMMISSIONED AND INSTALLED BY DIV. 28</td>
<td>BLK</td>
<td>SCE</td>
</tr>
<tr>
<td>1</td>
<td>DOOR CONTACT</td>
<td>679-05HM</td>
<td>BLK</td>
<td>SCE</td>
</tr>
<tr>
<td>1</td>
<td>WIRE HARNESS</td>
<td>CON (VERIFY LENGTH AND QUANTITY REQUIRED)</td>
<td>SCH</td>
<td></td>
</tr>
</tbody>
</table>

FIELD VERIFY EXISTING KEYWAY/MATCH AND INTEGRATE INTO EXISTING KEY SYSTEM. MOUNT 429A HEAD SEAL PRIOR TO MOUNTING CLOSER. 328AA IS TO BE USED AS JAMB SEALS.

OPERATIONAL DESCRIPTION: CREDENTIAL READER DEVICE IS TO RELEASE THE ELECTRIC STRIKE ALLOWING THE DOOR TO BE OPENED. KEYED INGRESS IS ALSO AVAILABLE. IMMEDIATE EGRESS IS ALWAYS AVAILABLE. DOOR STATUS (OPEN/CLOSED) IS MONITORED.

ITEMS TO BE PROVIDED BY THE DIVISION 28 SUPPLIER:
CREDENTIAL READER DEVICE.
REQUIRED POWER AND WIRING TO THE CREDENTIAL READER DEVICE, ELECTRIC STRIKE AND THE DOOR POSITION SWITCH.
HARDWARE GROUP NO. 11
For use on Door #(#s):
109  110
Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PULL PLATE</td>
<td>8302 10&quot; 4&quot; X 16&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>PUSH PLATE</td>
<td>8200 4&quot; X 16&quot;</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>MOP PLATE</td>
<td>8400 4&quot; X 1&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>WALL STOP</td>
<td>WS406/407CCV</td>
<td>630</td>
<td>IVE</td>
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</tbody>
</table>

PUSH/PULL. SELF-CLOSING.

HARDWARE GROUP NO. 12
For use on Door #(#s):
101A  106
Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
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</thead>
<tbody>
<tr>
<td>3</td>
<td>HINGE</td>
<td>5BB1 4.5 X 4.5</td>
<td>652</td>
<td>IVE</td>
</tr>
<tr>
<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO</td>
<td>626</td>
<td>SCH</td>
</tr>
<tr>
<td>1</td>
<td>OH STOP</td>
<td>90S</td>
<td>630</td>
<td>GLY</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>KICK PLATE</td>
<td>8400 10&quot; X 2&quot; LDW B-CS</td>
<td>630</td>
<td>IVE</td>
</tr>
</tbody>
</table>
HARDWARE GROUP NO. 13

For use on Door #107A

Provide each SGL door(s) with the following:

<table>
<thead>
<tr>
<th>QTY</th>
<th>DESCRIPTION</th>
<th>CATALOG NUMBER</th>
<th>FINISH</th>
<th>MFR</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CONT. HINGE</td>
<td>112XY</td>
<td>628</td>
<td>IVE</td>
</tr>
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<td>1</td>
<td>STOREROOM LOCK</td>
<td>ND80PD RHO</td>
<td>626</td>
<td>SCH</td>
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<td>ELECTRIC STRIKE</td>
<td>6211AL FSE DSLC CON 12/16/24/28</td>
<td>630</td>
<td>VON</td>
</tr>
<tr>
<td>1</td>
<td>OH STOP</td>
<td>100S</td>
<td>630</td>
<td>GLY</td>
</tr>
<tr>
<td>1</td>
<td>SURFACE CLOSER</td>
<td>4040XP EDA</td>
<td>689</td>
<td>LCN</td>
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<tr>
<td>1</td>
<td>PA MOUNTING PLATE</td>
<td>4040XP-18PA</td>
<td>689</td>
<td>LCN</td>
</tr>
<tr>
<td>1</td>
<td>BLADE STOP SPACER</td>
<td>4040XP-61</td>
<td>689</td>
<td>LCN</td>
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<tr>
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<td>A</td>
<td>ZER</td>
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<tr>
<td>1</td>
<td>MULTITECH READER</td>
<td>CARD READER FURNISHED, COMMISSIONED AND INSTALLED BY DIV. 28</td>
<td>BLK</td>
<td>SCE</td>
</tr>
<tr>
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<td>PROVIDE FACTORY POINT TO POINT WIRING DIAGRAMS</td>
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<td>CON (VERIFY LENGTH AND QUANTITY REQUIRED)</td>
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<tr>
<td>1</td>
<td>WEATHERSTRIP BY DOOR/FRAME MANUFACTURER</td>
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</table>

OPERATIONAL DESCRIPTION: CREDENTIAL READER DEVICE IS TO RELEASE THE ELECTRIC STRIKE ALLOWING THE DOOR TO BE OPENED. KEYED INGRESS IS ALSO AVAILABLE. IMMEDIATE EGRESS IS ALWAYS AVAILABLE. DOOR STATUS (OPEN/CLOSED) IS MONITORED.

ITEMS TO BE PROVIDED BY THE DIVISION 28 SUPPLIER:
CREDENTIAL READER DEVICE.
REQUIRED POWER AND WIRING TO THE CREDENTIAL READER DEVICE, ELECTRIC STRIKE AND THE DOOR POSITION SWITCH.

END OF SECTION 08 7100
SECTION 08 8000 – GLAZING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Doors and sidelites.
2. Transaction window.
3. Glazed entrances.

1.2 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.
B. Samples: 12-inch-square, for each type of glass product indicated, other than monolithic clear float glass.
C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
D. Warranties: Special warranties specified in this Section.

1.3 DEFINITIONS

A. Glass Thickness: Indicated by thickness designations in millimeters according to ASTM C 1036.
B. Inter-Space: Space between lites of an insulating-glass unit that contains dehydrated air or a specified gas.
C. Deterioration of Coated Glass: Defects develops from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
D. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage or practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

1.4 PERFORMANCE REQUIREMENTS

A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions.
C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

D. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.

1. Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer’s name, type of glass, thickness, and safety glazing standard with which glass complies.

E. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.


1.5 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association Glazier Certification Program as Level 2 (Senior Glaziers) or Level 3 (Master Glaziers).

B. Sing Source Responsibility for Glass: To ensure consistent quality of appearance and performance, provide materials produced by a single manufacturer or fabricator for each kind and condition of glass indicated and composed of primary glass obtained from a single source for each type and class required.

1.6 DELIVERY, STORAGE AND HANDLING

A. Protect glazing materials according to manufacturer’s written instruction and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers or when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1.8 WARRANTY

A. General: Warranties shall be in addition to, and not a limitation of, other rights the Owner may have under the Contract Documents.
B. All material shall be free from manufacturer defects and installation workmanship. Any material or workmanship judged to be defective shall be replaced at no cost to the Owner.

C. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form in which coated-glass manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.

1. Warranty Period: 10 years from date of Substantial Completion.

D. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

C. Windborne-Debris-Impact Resistance: Provide exterior glazing that passes basic protection testing requirements in ASTM E11996 for appropriate wind zone when tested according to ASTM E 18886. Test specimens shall be no smaller in width and length than glazing indicated for use on the Project and shall be installed in same manner as glazing indicated for use on the Project.

2.2 GLASS PRODUCTS

A. Annealed Float Glass: ASTM C 1036, Type I (transparent flat glass); Quality-Q3; of class indicated.

B. Tempered Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

C. Heat-Treated Float Glass: ASTM C 1048; Type I; Quality-Q3; Class I (clear) unless otherwise indicated; of kind and condition indicated.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.

2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.

3. For uncoated glass, comply with requirements for Condition A.

4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.

D. Insulating-Glass Units, General: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, and complying with ASTM E 774 for Class CBA units and with requirements specified in this Article and in Part 2 "Insulating-Glass Units" Article.

1. Provide Kind HS (heat-strengthened) float glass in place of annealed glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
2. Overall Unit Thickness and Thickness of Each Lite: Dimensions indicated for insulating-glass units are nominal and the overall thicknesses of units are measured perpendicularly from outer surfaces of glass lites at unit's edge.
4. Spacer Specifications: Manufacturer's standard spacer material and construction.
5. Spacer Specifications: Manufacturer's standard spacer material and construction complying with the following requirements:
   a. Spacer Material: Aluminum with mill or clear anodic finish.
   b. Corner Construction: Manufacturer's standard corner construction.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x deg F.
2. Solar Heat-Gain, Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
3. Visible Reflectance: Center-of-glazing values, according to NFRC 300.

2.3 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

1. Construction: Laminate glass with polyvinyl butyral interlayer ionomeric polymer interlayer or cast-in-place and cured-transparent-resin interlayer to comply with interlayer manufacturer's written instructions.
2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
3. Interlayer Color: Clear unless otherwise indicated.

B. Windborne-Debris-Impact-Resistant Laminated Glass: Comply with requirements specified above for laminated glass except laminate glass with one of the following to comply with interlayer manufacturer's written instructions:

1. Polyvinyl butyral interlayer.
2. Polyvinyl butyral interlayers reinforced with polyethylene terephthalate film.
3. Ionomeric polymer interlayer.

C. Cast-in-place and cured-transparent-resin interlayer reinforced with polyethylene terephthalate film.
2.4 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:
2. EPDM, ASTM C 864.
4. Thermoplastic polyolefin rubber, ASTM C 1115.
5. Any material indicated above.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned gaskets of material indicated below; complying with ASTM C 509, Type II, black; and of profile and hardness required to maintain watertight seal:
1. Neoprene.
2. EPDM.
4. Thermoplastic polyolefin rubber.
5. Any material indicated above.

2.5 GLAZING SEALANTS

A. General: Provide products of the type indicated with the following requirements:
1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. VOC Content: For sealants used inside of the weatherproofing system, not more than 250 g/L when calculated according to 40 CFR 59, Subpart D.
4. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
1. Type and Grade: S (single component) and NS (non-sag).
2. Use Related to Exposure: NT (non-traffic).
3. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.
4. Applications: Glazing; toe, heel and cap beads.
5. Class 50 Neutral-Curing Silicone Glazing Sealant:
   a. Products:
      1) Dow Corning Corporation; 795.
      2) GE Silicones; SilPruf NB SCS9000.
      3) Pecora Corporation; 895.
      4) Tremco; Spectrem 2 or Spectrem 3.

6. Class 25 Neutral-Curing Silicone Glazing Sealant:
   a. Products:
      1) Dow Corning Corporation; 795.
      2) GE Silicones; UltraGlaze SSG4000.
2.6 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

1. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
2. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.8 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

2.8 MONOLITHIC FLOAT-GLASS SAFETY UNITS:

A. Glass Type: Uncoated clear and tempered float-glass units GLT-1 and GLT-4.

1. Thickness 6.0 mm.
2. Kind FT – fully tempered where indicated of required by code.

2.9 INSULATING-GLASS UNITS

A. Glass Type: Low-E-Coated, Solar Control Clear Insulating-Glass Units.

1. Overall Unit Thickness: 1” at typical openings; 5/8” at door lites, or as indicated.
2. Thickness of Each Glass Lite: 1 inch.
3. Interspace Content: Argon gas.
4. Outdoor Lite: Class 1 (clear) float glass.
   a. Kind FT – fully tempered at GLT-12T/GLT-15T/GLT-16T, or where required by code.

5. Indoor Lite: Class 1 (clear) float glass.
   a. Kind FT – fully tempered at GLT-12T/GLT-15T/GLT-16T, or where required by code.

6. Low-E Coating: Pyrolytic or sputtered on second surface.

7. U-Value: 0.30.

8. Solar heat gain coefficient: 0.40 or less.

9. Visible Transmittance: 0.49 or less.

10. Fully tempered where indicated or required by code.

PART 3 - EXECUTION

3.1 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass lites where length plus width is larger than 50 inches.

H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

3.2 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Apply heel bead of elastomeric sealant.
F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

G. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.3 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. Wash glass on both exposed surfaces not more than four (4) days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

END OF SECTION 08 8000
SECTION 08 8300 – MIRRORS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Annealed monolithic glass mirrors with stainless steel channel frames.

1.2 SUBMITTALS

A. Product Data: For mirror hardware.

B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachments to other work.

C. Product Certificates: For each type of mirror, signed by product manufacturer.

1.3 QUALITY ASSURANCE

A. Glazing Publications: Comply with GANA's "Glazing Manual" and GANA Mirror Division's "Mirrors, Handle with Extreme Care: Tips for the Professional on the Care and Handling of Mirrors" unless more stringent requirements are indicated

B. Safety Glazing Products: For tempered mirrors, provide products complying with testing requirements in 16 CFR 1201 for Category II materials.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with mirror manufacturer's written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors, protected from moisture including condensation.

1.5 WARRANTY

A. Special Warranty: Manufacturer's standard form, made out to Owner and signed by mirror manufacturer agreeing to replace mirrors that deteriorate, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated in second subparagraph below.

1. Deterioration of Mirrors: Defects developed from normal use that are attributable to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning mirrors contrary to mirror manufacturer's written instructions. Defects include discoloration, black spots, and clouding of the silver film.

2. Warranty Period: Fifteen (15) years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 MANUFACTURERS
   A. Basis-of-Design: Subject to compliance with requirements, provide Bobrick B-165 Series mirror with stainless steel channel frame, or approved equal.

2.2 MIRROR FRAME
   A. Type 430 stainless steel, 1/2" x 1/2" x 3/8" channel with 1/4" return at rear.
   B. All exposed surfaces shall have bright polished finish.
   C. One-piece frame with 90 degree mitered corners.
   D. Galvanized steel back with integral horizontal hanging brackets near the top for hanging the mirror and near the bottom to prevent the bottom of mirror from pulling away from the wall.
   E. Locking Devices to secure mirror to concealed wall hanger.

2.3 MIRROR
   A. No. 1 quality, 1/4" select float glass.
      1. Selected for silvering.
      2. Electrolytically copper-plated by the galvanic process.
      3. Guaranteed for 15 years against silver spoilage.
   B. Corners protected by friction-absorbing filler strips.
   C. Back protected by full-size, shock-absorbing, water-resistant, nonabrasive, 3/16" thick polyethylene padding.

2.4 CONCEALED WALL HANGER
   A. 20-gauge galvanized steel, incorporating lower support member, forming rigid rectangle, which engages lower backplate louvers to keep bottom of mirror against the wall.

PART 3 - EXECUTION

3.1 INSTALLATION
   A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.
   B. Provide a minimum air space of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.
   C. Mount wall hanger on wall with screws at points indicated. For plaster or drywall construction, provide backing to comply with local building codes, then secure wall hanger with screws.
D. When providing a concealed backing, allow backing to cover minimum range of mounting hole locations per manufacturer’s written instructions.

E. For other wall surfaces, provide fiber plugs or expansion shields for use with screws, or provide 1/8” toggle bolts or expansion bolts.

F. Hang mirror on wall hanger with all four backplate louvers engaged behind horizontal wall hanger members.

G. Snap Locking Design: Locking devices automatically secure mirror to concealed wall hanger when it is lowered into final position.

H. Screw Locking Design: Lock mirror to wall hanger by tightening Phillips-head locking screws that are concealed in the bottom of frame at points indicated per manufacturer’s written instructions.

I. Protect mirrors from breakage and contaminating substances resulting from construction operations.

J. Do not permit edges of mirrors to be exposed to standing water.

K. Maintain environmental conditions that will prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

END OF SECTION 08 8300
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Non-load-bearing steel framing systems for interior gypsum board assemblies.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. STC-Rated Assemblies: Provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413.

2.2 FRAMING SYSTEMS

A. Recycled Content of Steel Products: Provide products with average recycled content of steel products such that postconsumer recycled content plus one-half of preconsumer recycled content is not less than 25 percent.

B. Steel Studs and Runners: ASTM C 645, with flange edges of studs bent back 90 degrees and doubled over to form 3/16-inch-wide minimum lip (return), and complying with the following requirements for minimum thickness of base (uncoated) metal:
   1. Unless indicated otherwise, use 25 gauge for partitions up to 12'-0" high. Partitions over 12'-0" high increase stud gage to 20 gauge.
   2. Unless indicated otherwise, use 20 gauge studs at door jambs and heads.

C. Slip-Type Head Joints: Where indicated, provide one of the following in thickness not less than indicated for studs and in width to accommodate depth of studs:
   1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch-deep flanges, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
   2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch-deep flanges and fastened to studs, and outer runner sized to friction fit inside runner.
   3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes due to deflection of structure above.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
         2) MBA Building Supplies; FlatSteel Deflection Track.
         3) Steel Network Inc. (The); VertiClip SLD or VertiTrack VTD Series.
         4) Superior Metal Trim; Superior Flex Track System (SFT).
         5) Telling Industries; Vertical Slip Track or Vertical Slip Track II.
         6) Approved equal.
D. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
   1. Minimum Base-Metal Thickness: As indicated on Drawings.

E. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
   1. Minimum Base-Metal Thickness: As indicated on Drawings.
   2. Depth: As indicated on Drawings.

2.3 AUXILIARY MATERIALS

A. Fasteners for Metal Framing: Provide fasteners of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel framing and furring members securely to substrates involved; complying with the recommendations of gypsum board manufacturers for applications indicated.

B. Isolation Strip at Exterior Walls: Provide asphalt saturated organic felt.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
   1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C 841 that apply to framing installation.
   2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C 1063 that apply to framing installation.
   3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C 844 that apply to framing installation.
   4. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.
1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.

2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
   a. Install two studs at each jamb unless otherwise indicated.
   b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
   c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

END OF SECTION 09 2216
SECTION 09 2900 – GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Interior gypsum board.
   2. Tile backing panels.
   3. Sound attenuation blankets.
   4. Acoustical sealant.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For the following products:
   1. Trim Accessories: Full-size Sample in 12-inch long length for each trim accessory indicated.
   2. Textured Finishes: Manufacturer’s standard size for each textured finish indicated and on the same backing indicated for the Work.

1.3 QUALITY ASSURANCE

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Single-Source Responsibility for Panel Products: Obtain each type of gypsum board and other panel products from a single manufacturer.

D. Single-Source Responsibility for Finishing Materials: Obtain finishing materials from either the same manufacturer that supplies gypsum board and other panel products or from a manufacturer acceptable to gypsum board manufacturer.

E. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.

   1. Install mockups for the following:
      a. Each level of gypsum board finish indicated for use in exposed locations.
      b. Each textured finish indicated.
   
   2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
   
   3. Simulate finished lighting conditions for review of mockups.
   
   4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
PART 2 - PRODUCTS

2.1 INTERIOR GYPSUM BOARD

A. General: Complying with ASTM C 36/C 36M or ASTM C 1396/C 1396M, as applicable to type of gypsum board indicated and whichever is more stringent.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Temple-Inland.
   b. American Gypsum Co.
   c. G-P Gypsum.
   d. Lafarge North America Inc.
   e. National Gypsum Company.
   f. USG Corporation.
   g. Approved Equal.

B. Regular Type:
   1. Thickness: 1/2 inch.
   2. Long Edges: Tapered.

C. Type X:
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.

D. Type C (as required by specific UL assemblies):
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.

E. Ceiling Type: Manufactured to have more sag resistance than regular-type gypsum board.
   1. Thickness: 1/2 inch.
   2. Long Edges: Tapered.

F. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.
   1. Core: 5/8 inch, Type X.
   2. Long Edges: Tapered.

G. Resilient Furring Channels: 1/2-inch deep, steel sheet members designed to reduce sound transmission.
   1. Configuration: Asymmetrical or hat shaped.

2.2 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer’s standard edges.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Georgia-Pacific Gypsum; DensShield Tile Backer.
      b. Approved Equal.
2. Core: As indicated on Drawings.

3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

B. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer’s standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Custom Building Products; Wonderboard.
   b. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
   c. James Hardie Building Products, Inc.; Hardiebacker.
   d. USG Corporation; DUROCK Cement Board.

2. Thickness: As indicated on Drawings.

C. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274

2.3 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping compound.
   a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use drying-type, all-purpose compound.

D. Joint Compound for Tile Backing Panels:

1. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
3. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.4 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, or rolled zinc.
2. Shapes:
a. Cornerbead.
b. Bullnose bead.
c. LC-Bead: J-shaped; exposed long flange receives joint compound.
d. U-Bead: J-shaped; exposed short flange does not receive joint compound.

Expansion (control) joint.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Fry Reglet Corp.
      b. Gordon, Inc.
      c. Pittcon Industries.
   2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B221, Alloy 6063-T5.
   3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer’s written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.
   1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings as demonstrated by testing according to ASTM E 90.
   1. Products: Subject to compliance with requirements, provide acoustical joint sealant by one of the following manufacturers:
      a. Accumetric LLC; BOSS 824 Acoustical Sound Sealant.
      b. Grabber Construction Products; Acoustical Sealant GSC.
      c. Pecora Corporation; AC-20 FTR.
      e. USG Corporation; SHEETROCK Acoustical Sealant.
      f. Approved Equal.
   2. Acoustical joint sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Thermal Insulation: As specified in Division 07 Section "Thermal Insulation."
G. Vapor Retarder: As specified in Division 07 Section "Thermal Insulation."

2.6 TEXTURED FINISHES

A. Primer: As recommended by textured finish manufacturer.

B. Aggregate Finish: Water-based, job-mixed, aggregated, drying-type texture finish for spray application.
   1. Products: Subject to compliance with requirements, provide products by one of the following manufacturers:
      a. G-P Gypsum; Georgia-Pacific Ceiling Textures/Vermiculite.
      b. USG Corporation; SHEETROCK Wall and Ceiling Spray Texture (Aggregated).
      c. Approved equal.

C. Texture: Orange peel.

PART 3 - EXECUTION

3.1 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.

C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch wide spaces at these locations, and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

3.2 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Regular Type: As indicated on Drawings.
   2. Type X: Where required for fire-resistance-rated assembly.
   3. Type C: As required by specific UL assemblies.
   4. Ceiling Type: As indicated on Drawings.
   5. Moisture- and Mold-Resistant Type: As indicated on Drawings.

3.3 APPLYING TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A108.1, at locations indicated to receive tile.

B. Water-Resistant Gypsum Backing Board: At locations indicated. Install with 1/4-inch gap where panels abut other construction or penetrations.

C. Areas Not Subject to Wetting: Install regular-type gypsum wallboard panels to produce a flat surface except at showers, tubs, and other locations indicated to receive water-resistant panels.

D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.
3.4 APPLYING ACOUSTICAL SEALANT

A. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

C. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners.
   2. Bullnose Bead: Use at outside corners.
   3. LC-Bead: Use where indicated.
   4. U-Bead: Use where indicated.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile.
   3. Level 3: Where indicated on Drawings.
   4. Level 4: At panel surfaces that will be exposed to view and under wall coverings, unless otherwise indicated.
      a. Primer and its application to surfaces are specified in other Division 09 sections.
   5. Level 5: Where indicated on Drawings.
      a. Primer and its application to surfaces are specified in other Division 09 Sections.

E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.

F. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 APPLYING TEXTURE FINISHES

A. Surface Preparation and Primer: Prepare and apply primer to gypsum panels and other surfaces receiving texture finishes. Apply primer to surfaces that are clean, dry, and smooth.
3.8 PROTECTION

A. Protect adjacent surfaces from drywall compound and finishes and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall installation.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, or mold damaged.
   
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 09 2900
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Ceramic wall, floor, and base tile.
   2. Waterproof membrane for mud-set tile installations.

B. Related Sections include the following:
   1. Division 07 Section “Joint Sealants.”
   2. Division 09 Section “Gypsum Board” for tile backing panels.

1.2 REFERENCES

A. The following specifications and standards are incorporated by reference:

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples: Assembled samples, with grouted joints, for each type and composition of tile and for each color and finish required.

D. Grout samples in duplicate indicating color range anticipated, texture.

E. Material Test Reports: For each tile-setting and -grouting product.

1.4 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain all tile of same type and color or finish from one source or producer.
   1. Obtain tile from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section through one source from a single manufacturer for each product:
   1. Joint sealants.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement in ANSI A137.1 for labeling sealed tile packages.
B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Store liquid latexes and emulsion adhesives in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size.

PART 2 - PRODUCTS

2.1 GENERAL

A. Factory Blending: For tile exhibiting color variations within ranges selected during Sample submittals, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

B. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer, unless otherwise indicated.

C. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.2 TILE

A. Manufacturers: Subject to compliance with requirements, provide ceramic tile from one of the following manufacturers:

1. American Olean; Division of Dal-Tile International Inc.
2. Crossville, Inc.
3. Daltile; Division of Dal-Tile International, Inc.
4. Approved Equal.

B. Ceramic Wall, Floor, and Base Tile:

1. Locations: See Drawings.
2. Colors and Patterns: See Room Finish List.

C. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.
2.3 ACCESSORY MATERIALS

A. Thresholds:
1. Fabricate to provide transition between adjacent floor finishes. Bevel edges at 1:2 slope, limit height of bevel to 1/2 inch or less, and finish bevel to match face of threshold.

B. Waterproofing and Crack-Suppression Membranes for Mud-Set Tile Installations: Manufacturer's standard product that complies with ANSI A118.10
   a. Available Products:
      1) Custom Building Products; Trowel & Seal Waterproofing and Anti-Fracture Membrane.
      2) LATICRETE International Inc.; Laticrete 9235 Waterproof Membrane.
      3) MAPEI Corporation; PRP M19.
      4) Summitville Tiles, Inc.; S-9000.

2.4 SETTING AND GROUTING MATERIALS

A. Manufacturers:
2. Boiardi Products Corporation.
5. C-Cure.
6. Custom Building Products.
7. DAP, Inc.
8. Jamo Inc.
9. LATICRETE International Inc.
10. MAPEI Corporation.
11. Southern Grouts & Mortars, Inc.
12. Summitville Tiles, Inc.
13. TEC Specialty Products Inc.

B. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4, consisting of the following:
   1. Prepackaged dry-mortar mix containing dry, redispersible, ethylene vinyl acetate additive to which only water must be added at Project site.
   2. Prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
   3. For wall applications, provide mortar that complies with requirements for non-sagging mortar in addition to the other requirements in ANSI A118.4.

C. Organic Adhesive: ANSI A136.1, Type I, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Water-Cleanable, Tile-Setting Epoxy Adhesive: ANSI A118.3, with a VOC content of 65 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Standard Sanded Cement Grout: ANSI A118.6, color as selected by Architect.

F. Epoxy Grout, Water-Cleanable: ANSI A118.3.
   1. Provide product capable of withstanding continuous and intermittent exposure to temperatures of up to 140 deg F and 212 deg F, respectively, and certified by manufacturer for intended use.

G. Polymer-Modified Tile Grout: ANSI A118.7. Use sanded grout for joints 1/8 inch and wider and unsanded grout for joints narrower than 1/8 inch.
1. Polymer Type: Acrylic resin or styrene-butadiene rubber in liquid-latex form for addition to prepackaged dry-grout mix.
2. Color: As selected by Architect from manufacturer’s standard range.

H. Expansion Joints:
1. Sealant: Two-component sealant shall comply with Federal Specification TT-S-227e; use Type II (non-sag) for joints in vertical surfaces and Type I (self-leveling) for joints in horizontal surfaces.
2. Back-Up Strips: Flexible and compressible type of closed-cell foam polyethylene or butyl rubber, rounded at surface to contact sealant and as recommended by sealant manufacturers.

I. Provide other materials not specifically described but required for a complete and proper installation.

2.5 ELASTOMERIC SEALANTS

A. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.
1. Products:
   a. Dow Corning Corporation; Dow Corning 786.
   b. GE Silicones; Sanitary 1700.
   c. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
   d. Tremco, Inc.; Tremsil 600 White.

2.6 MISCELLANEOUS MATERIALS

A. Trowelable Underlayment and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Cementitious Backer Units: ANSI A118.9 in maximum lengths available to minimize end-to-end butt joints.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. C-Cure; C-Cure Board 990.
   b. Custom Building Products; Wonderboard.
   c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
   d. USG Corporation; DUROCK Cement Board.
2. Thickness: As indicated.

C. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

D. Grout Sealer: Manufacturer’s standard silicone product for sealing grout joints that does not change color or appearance of grout.
1. Products:
   b. Bostik; CeramaSeal Grout Sealer.
   c. C-Cure; Penetrating Sealer 978.
   d. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
   f. TEC Specialty Products Inc.; TA-256 Penetrating Silicone Grout Sealer.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.
B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.
   1. Verify that substrates for setting tile are firm; dry; clean; free of oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 Series of tile installation standards for installations indicated.
   2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
   3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds and other substances that contain soap, wax, oil, or silicone, that are incompatible with tile-setting materials.

B. Blending: For tile exhibiting color variations within ranges selected during Sample submittals, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 Series "Specifications for Installation of Ceramic Tile" that apply to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.


C. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated. Joints in wall tile shall be aligned vertically and horizontally; staggered joints will not be accepted.

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   1. Wall, Floor and Base Tile: 3/16 inch.
G. Lay out tile wainscots to next full tile beyond dimensions indicated.

H. Rub exposed edges smooth.

I. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Locate joints in tile surfaces directly above joints in concrete substrates.
   2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

J. Grout tile to comply with requirements of the following tile installation standards:
   1. For ceramic tile grouts (sand-portland cement; dry-set, commercial Portland cement; and latex-Portland cement grouts), comply with ANSI A108.10.
   2. For chemical-resistant epoxy grouts, comply with ANSI A108.6.

K. At showers, tubs, and where indicated, install cementitious backer units and treat joints to comply with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

L. Grout Sealer: Apply grout sealer to cementitious grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer that has gotten on tile faces by wiping with soft cloth.

3.4 CLEANING AND PROTECTING

A. Cleaning: Upon completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove epoxy and latex-Portland cement grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

B. Close off work spaces to traffic during installation for at least 48 hours after completion of work.

C. Tiled vertical outside corners shall be protected with board corner strips in areas used as passageways.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09 3000
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes:
   1. Acoustical tiles and concealed suspension systems for ceilings.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordination Drawings: Drawn to scale and coordinating acoustical tile ceiling installation with hanger attachment to building structure and ceiling mounted items. Show size and location of initial access modules.

C. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
   1. Acoustical Tile: Set of 6-inch-square Samples of each type, color, pattern, and texture.

D. Maintenance Data.

1.3 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of acoustical ceiling tile and supporting suspension system through one source from a single manufacturer.

B. Fire-Test-Response Characteristics:
   1. Fire-Resistance Characteristics: Where indicated, provide acoustical tile ceilings identical to those of assemblies tested for fire resistance per ASTM E 119 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction.
      a. Fire-Resistance Ratings: Indicated by design designations from UL’s "Fire Resistance Directory" or from the listings of another testing and inspecting agency.
      b. Identify materials with appropriate markings of applicable testing and inspecting agency.
   2. Surface-Burning Characteristics: Provide acoustical tiles with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
      a. Smoke-Developed Index: 450 or less.

1.4 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Acoustical Ceiling Units: Full-size tiles equal to 3.0 percent of quantity installed.
2. Suspension System Components: Quantity of each concealed grid and exposed component equal to 3.0 percent of quantity installed.
3. Hold-Down Clips: Equal to 3.0 percent of amount installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical tiles, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical tiles, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical tiles carefully to avoid chipping edges or damaging units in any way.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install acoustical tile ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 COORDINATION

A. Coordinate layout and installation of acoustical tiles, direct applied tiles, and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong World Industries, Inc.
   2. USG Interiors, Inc.
   3. Chicago Metallic Corporation.
   4. Cellotex.
   5. CertainTeed.

B. Products: See Floor Finish List.

C. Proprietary Names: Use of manufacturer’s proprietary product names to designate color or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer’s material data and certificates of performance for proposed substitutions.

2.2 ACOUSTICAL TILE CEILINGS

A. Acoustical Tile Standard: Provide manufacturer's standard tiles of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances, unless otherwise indicated.
B. Acoustical Tile Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical tiles are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

C. Coating-Based Antimicrobial Treatment: Provide acoustical tiles with face and back surfaces coated with antimicrobial treatment consisting of manufacturer's standard formulation with fungicide added to inhibit growth of mold and mildew and showing no mold or mildew growth when tested according to ASTM D 3273.

D. Tile-Based Antimicrobial Treatment: Provide acoustical tiles treated with manufacturer's standard antimicrobial solution that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria.

E. Acoustical Tile: See Floor Finish List.

2.3 METAL SUSPENSION SYSTEM FOR ACOUSTICAL TILE CEILING

A. Products: Subject to compliance with requirements, provide products by one of the following:

1. Armstrong World Industries, Inc.
2. USG Interiors, Inc.
3. Chicago Metallic Corporation.
4. Approved Equal.

B. Metal Suspension System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635.

C. Access: Upward, with each access unit identified by manufacturer's standard unobtrusive markers.

D. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

1. High-Humidity Finish: Comply with ASTM C 635 requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

E. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.

1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.

   1. Type: Post-installed expansion anchors.
   2. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition.
   3. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 alloy 304 or 316 for bolts; alloy 304 or 316 for anchor.

2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated, and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing per ASTM E 1190, conducted by a qualified testing and inspecting agency.
F. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

3. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch-diameter wire.

G. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

H. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

I. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

J. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical tiles.

K. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet, pre-painted, electrolytically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation, with pre-finished 15/16-inch-wide metal caps on flanges.

2.4 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that fit acoustical tile edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.

1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.
3. For narrow-face suspension systems, provide suspension system and manufacturer's standard edge moldings that match width and configuration of exposed runners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical tile ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical tile ceilings.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical tiles to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width tiles at borders, and comply with layout shown on reflected ceiling plans.
3.3 INSTALLATION, GENERAL

A. General: Install acoustical tile ceilings to comply with ASTM C 636 UBC Standard 25-2 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
3. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, counter-splaying, or other equally effective means.
4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
8. Do not attach hangers to steel deck tabs.
9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical tiles.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical tiles in coordination with suspension system and exposed moldings and trim. Place splines or suspension system flanges into kerfed edges so tile-to-tile joints are closed by double lap of material.
G. Install acoustical tiles with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut tiles at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical tiles as follows:
   a. As indicated on reflected ceiling plans.

2. For square-edged tiles, install tiles with edges fully hidden from view by flanges of suspension system runners and moldings.

3. For reveal-edged tiles on suspension system runners, install tiles with bottom of reveal in firm contact with top surface of runner flanges.

4. For reveal-edged tiles on suspension system members with box-shaped flanges, install tiles with reveal surfaces in firm contact with suspension system surfaces and tile faces flush with bottom face of runners.

5. Paint cut edges of tile remaining exposed after installation; match color of exposed tile surfaces using coating recommended in writing for this purpose by acoustical tile manufacturer.

6. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by tile manufacturer's written instructions, unless otherwise indicated.

7. Install clean-room gasket system in areas indicated, sealing each tile and fixture as recommended by tile manufacturer's written instructions.

8. Protect lighting fixtures and air ducts to comply with requirements indicated for fire-resistance-rated assembly.

3.4 CLEANING

A. Replace damaged and broken tiles.

B. Clean exposed surfaces of acoustical tile ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 5123
PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Resilient base.
   2. Resilient molding accessories.

B. Related Sections include the following:
   1. Division 09 Section “Tile Carpeting.”
   2. Division 09 Section “Resilient Tile Flooring.”

1.2 SUBMITTALS

A. Product Data: For each product indicated.

B. Samples: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E648 or NFPA 253 by a qualified testing agency.

   1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive resilient products.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Johnsonite.
   2. Flexco.
   3. Armstrong.
   4. Approved Equal.

B. Products: See Floor Finish Plan.
2.2 RESILIENT BASE

   1. Material Requirement: Type TV (vinyl, thermoplastic).
   3. Flexibility: Will not crack, break, or show any signs of fatigue when bent around a 1/4 inch diameter cylinder.
   4. Style: Cove base with toe.
   5. Meets or exceeds the performance requirements for resistance to heat/light aging, chemicals, and dimensional stability when tested to the methods described in ASTM F 1861.

B. Thickness: 0.80 inch.

C. Height: 4 inches.

D. Lengths: 4 feet straight or 120 feet coiled lengths.

E. Outside Corners: Job formed.

F. Inside Corners: Job formed.

G. Height: Minimum 4 inches and as indicated on Drawings.

H. Lengths: Coils in manufacturer’s standard length.

I. Locations: See Drawings.

J. Finish, Colors and Patterns: See Floor Finish Plan.

2.3 RESILIENT ACCESSORIES

A. Vinyl Transition Strips:
   1. At dissimilar flooring materials.
   2. At direct glue carpet.
   3. At other locations as indicated.

2.4 RESILIENT MOLDING ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Johnsonite.
   2. Flexco.
   3. Armstrong.
   4. Approved Equal.
   5. Meets or exceeds the performance requirements for resistance to heat/light aging, chemicals, and dimensional stability when tested to the methods described in ASTM F 1861.

B. Description: Carpet edge for glue-down applications, reducer strip for resilient floor covering, joiner for tile and carpet, transition strips.

C. Material: Vinyl.

D. Profile and Dimensions: As indicated.

E. Colors and Patterns: As selected by Architect from manufacturer’s standard range.
2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.
   
   1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer's written recommendations to ensure adhesion of resilient products.

B. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.
   
   1. Do not install resilient products until they are the same temperature as the space where they are to be installed.

E. Areas to receive resilient products shall be clean, fully enclosed, weather tight, and maintained at a uniform temperature of at least 65°F for 24 hours immediately before installation.

F. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

G. Coiled resilient base shall be uncoiled and lay flat for at least 24 hours at 65°F prior to installation.

3.2 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Installation work should not begin until the work of all other trades, especially overhead trades, has been completed.

C. Areas to receive resilient base shall be maintained at a uniform temperature of at least 65°F for 24 hours during and for 24 hours after the installation is completed.

D. The resilient base and adhesives shall be conditioned in the same manner.

E. Floors and walls shall be clean, dry, free of dust, all paints, wallpaper, and all other foreign materials which may affect proper adhesive bonding.

F. Resilient bases shall not be installed on surfaces that will be exposed to drastic temperature changes or moisture.

G. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
H. Install resilient base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.

I. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

J. Do not stretch resilient base during installation.

K. Coiled wall base shall be uncoiled and lay flat for at least 24 hours at 65º F prior to installation.

L. Job-Formed Corners:

1. Outside Corners: Use straight pieces of maximum lengths possible. Form without producing discoloration (whitening) at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug fit without removing more than half the resilient base thickness.

2. Inside Corners: Use straight pieces of maximum lengths possible. Form by cutting an inverted V-shaped notch in toe of resilient base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

3.3 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer’s written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of carpet and floor coverings that would otherwise be exposed.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer’s written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.

2. Sweep and vacuum surfaces thoroughly.

3. Damp-mop surfaces to remove marks and soil.

   a. Do not wash surfaces until after time period recommended by manufacturer.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period. Use protection methods recommended in writing by manufacturer.

END OF SECTION 09 6513
SECTION 09 6519 – RESILIENT TILE FLOORING

PART 1 – GENERAL

1.1 SUMMARY
   A. Section Includes:
      1. Luxury vinyl tile.
   B. Related Sections Include:
      1. Division 09 Section “Resilient Wall Base and Accessories” for resilient wall base and other accessories installed with resilient tile flooring.

1.2 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
   C. Samples: Full-size units of each color and pattern of floor tile required.
   D. Maintenance data.

1.3 QUALITY ASSURANCE
   A. Fire-Test-Response Characteristics: As determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.
      1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

1.4 PROJECT CONDITIONS
   A. Maintain ambient temperatures within range recommended by manufacturer in spaces to receive floor tile.
   B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer.
   C. Close spaces to traffic during floor tile installation.
   D. Close spaces to traffic for 48 hours after floor tile installation.
   E. Install floor tile after other finishing operations, including painting, have been completed.

1.5 DELIVERY, STORAGE AND HANDLING
   A. Store floor tile and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg.

1.6 EXTRA MATERIALS
   A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Furnish one (1) box for every 50 boxes or fraction thereof, of each type, color, and pattern of flooring installed.

PART 2 – PRODUCTS

2.1 LUXURY VINYL FLOOR TILE

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:

1. Armstrong.
2. Mannington Mills, Inc.
4. Interface.
5. Approved Equal.


C. Products: See Floor Finish Plan.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, Portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

D. Adhesives: Water-resistant type recommended by manufacturer to suit floor tile and substrate conditions indicated.

1. Use adhesives that have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Floor Polish: Provide protective liquid floor polish products as recommended by manufacturer.

PART 3 – EXECUTION

3.1 PREPARATION

A. Prepare substrates according to manufacturer’s written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer. Proceed with installation only after substrates pass testing.
4. Moisture Testing: Perform tests recommended by floor covering manufacturer. Proceed with installation only after substrates pass testing.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until they are same temperature as space where they are to be installed.
1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, and dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent, nonstaining marking device.

G. Adhere floor tiles to flooring substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

H. Perform the following operations immediately after completing luxury vinyl flooring installation:

1. Remove adhesive and other blemishes from luxury vinyl flooring surfaces.
2. Sweep and vacuum luxury vinyl flooring thoroughly.
3. Damp-mop luxury vinyl flooring to remove marks and soil.
   a. Do not wash luxury vinyl flooring until after time period recommended by manufacturer.

3.3 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of floor tile.

B. Floor Polish: Remove soil, visible adhesive, and surface blemishes from floor tile surfaces before applying liquid floor polish.

1. Apply two coat(s).

C. Cover floor tile until Substantial Completion.
SECTION 09 6813 – TILE CARPETING

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Modular Carpet Tile.

B. Related Sections include the following:

1. Division 09 Section "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.2 SUBMITTALS

A. Product Data: For the following, including installation recommendations for each type of substrate:

1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.

B. Samples: For each exposed product and for each color and texture specified.

C. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
2. Carpet type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.

D. Maintenance Data: For carpet to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile and carpet cushion.

E. Warranties: Special warranties specified in this Section.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer, certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.


1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.5 PROJECT CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tile over concrete slabs until slabs have cured, are sufficiently dry to bond with adhesive, and have pH range recommended by carpet manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tile, install carpet tile before installing these items.

1.6 PRE-INSTALLATION MEETINGS

A. Pre-installation Conference: Review methods and procedures related to carpet installation, including:

1. Delivery, storage, and handling procedures.
2. Ambient conditions and ventilation procedures.
3. Subfloor preparation procedures, including relative humidity, moisture and alkalinity tests.

1.7 WARRANTY

A. Special Warranty for Carpet Tile: Manufacturer's standard form in which manufacturer agrees to repair or replace components of carpet tile installation that fails in materials or workmanship within specified warranty period.

1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
2. Failures include, but are not limited to, more than 10 percent loss of face fiber, edge raveling, snags, runs, loss of tuft bind strength, excess static discharge, and delamination.
3. Warranty Period: 10 years from date of Substantial Completion.

B. Special Installation Warranty: Installer's written warranty, co-signed by Contractor, agreeing to provide labor and materials to replace carpet tile and accessories that fail due to installation defects, including inadequate subflooring preparation and adhesion failures.

1. Warranty does not include failure due to vandalism or abuse.
2. Warranty Period: Five (5) years from date of Substantial Completion.
1.8 EXTRA MATERIALS

A. All usable pieces of carpet tile remaining after completion of the work shall be left with the Owner at the Project Site.

B. Provide 3% attic stock.

PART 2 - PRODUCTS

2.1 CARPET

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers:
   1. Shaw.
   2. Mohawk.
   3. Interface.
   4. Patcraft.
   5. Approved Equal.

B. Products: See Floor Finish Plan.

C. Antimicrobial Treatment: Manufacturer’s standard.

2.2 ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet cushion manufacturer.

B. Special Coatings: As recommended by floor adhesive manufacturers to suit indicated resilient products and substrate conditions.

C. Adhesives: Water-resistant, mildew-resistant, non-staining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet and is recommended or provided by carpet manufacturer.
   1. Adhesives shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Vinyl Transition Strips: Vinyl transition strip of width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:
1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet and cushion manufacturer.

2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving carpet.

3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with CRI 104, "Site Conditions; Floor Preparation," and with carpet tile manufacturer’s written installation instructions for preparing substrates indicated to receive carpet tiles.

B. Use trowelable leveling and patching compounds, according to manufacturer’s written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch, unless more stringent requirements are required by manufacturer’s written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile and cushion manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. Comply with CRI 104, Section 104 and with carpet tile manufacturers' written installation instructions and the following:

1. Direct-Glue-Down Installation: Comply with CRI 104, Section 9, "Direct Glue-Down Installation."

B. Comply with carpet tile manufacturer’s written recommendations for seam locations and direction of carpet tile; maintain uniformity of carpet tile direction and lay of pile. At doorways, center seams under the door in closed position.

C. Do not bridge building expansion joints with carpet tile.

D. Maintain dye lot integrity. Do not mix dye lots in same area.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, non-staining marking device.

H. Install pattern parallel to walls and borders.
3.4 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.

B. Protect installed carpet tile to comply with CRI 104, "Protecting Indoor Installations."

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer and carpet tile adhesive manufacturer.

END OF SECTION 09 6813
PART 1 – GENERAL

1.1 SUMMARY

A. This Section includes surface preparation and field painting of exposed interior items and surfaces.

   1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. “Paint” as used herein means all coating systems materials, including primers, emulsions, enamels, stains, sealers and fillers and other applied material whether used as prime, intermediate, or finish coats.

C. This Section includes surface preparation and the application of paint systems on the following interior substrates:

   1. Concrete.
   2. Steel.
   4. And as indicated.

D. Paint exposed surfaces, except where these Specifications indicate that the surface or material is not to be painted or is to remain natural. If an item or a surface is not specifically mentioned, paint the item or surface the same as similar adjacent materials or surfaces. If a color or finish is not indicated, Architect will select from standard colors and finishes available.

   1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron supports, and surfaces of mechanical and electrical equipment that do not have a factory-applied final finish.

F. Do not paint pre-finished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

   1. Prefinished items include the following factory-finished components:
      a. Finished mechanical and electrical equipment.
      b. Light fixtures.
      c. Wood doors.

   2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
      a. Furred areas.
      b. Ceiling plenums.
      c. Pipe spaces.
      d. Duct shafts.

   3. Finished metal surfaces include the following:
      a. Anodized aluminum.
      b. Stainless steel.

   4. Labels: Do not paint over UL, FMG, or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.2 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
2. Eggshell refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
3. Semi-gloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated, including printed statement of VOC content.

B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
   1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
   2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.
   3. Submit 2 Samples on the following substrates for Architect's review of color and texture only:
      a. Stained or Natural Wood: 4-by-8-inch Samples of natural- or stained-wood finish on representative surfaces.
      b. Ferrous Metal: 4-inch-square Samples of flat metal.
      c. Painted Gypsum Board: 6-inch square for each color with sheen, color and texture achieved.

1.4 QUALITY ASSURANCE

A. Materials shall be of manufacture, brand and quality as specified. Products of other manufacturers will not be accepted. Provide block fillers, primers and undercoat materials produced by the same manufacturer as the finish coats. All system components shall be compatible with one another and with substrates, as demonstrated by manufacturer based on testing and field experience.

B. Quality workmanship is required. Employ skilled craftsmen experienced in the use of the product involved with a record of successful service performance.

C. MPI Standards:
   1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."

1.5 DELIVERY, STORAGE AND HANDLING

A. Do not deliver materials to site until having received all written approvals of submitted information and samples.

B. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Manufacturer's stock number and date of manufacture.
   4. Contents by volume, for pigment and vehicle constituents.
   5. Thinning instructions.
6. Application instructions.
7. Color name and number.
8. VOC content.

C. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
   1. Keep storage area neat and orderly. Remove oily rags and waste daily.

D. Take all precautions to insure that workers and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and applications of paint.

1.6 PROJECT CONDITIONS

A. Apply waterborne paints only when temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when temperatures of surfaces to be painted and surrounding air temperature are between 45 and 95 deg F.

C. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg above the dew point; or to damp or wet surfaces.

D. Do not apply paint to surfaces in hot sunlight.

1.7 SEQUENCING AND SCHEDULING

A. Schedule cleaning and painting so that contaminants from cleaning process will not fall onto newly-painted surfaces.

1.8 EXTRA MATERIALS

A. Deliver extra materials equal to a minimum of one gallon of each type/color of paint supplied.

B. All containers shall be sealed for storage and identified with appropriate labels.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products from one of the following manufacturers:

   1. Benjamin Moore & Co.
   2. Sherwin Williams.
   3. Hallman Lindsay.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility:

   1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Material Quality: Provide manufacturer’s best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer’s product identification will not be acceptable. Use products with low VOC content when available.

C. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Floor Coatings: VOC not more than 100 g/L.
5. Shellacs, Clear: VOC not more than 730 g/L.
6. Shellacs, Pigmented: VOC not more than 550 g/L.
7. Flat Topcoat Paints: VOC content of not more than 50 g/L.
8. Nonflat Topcoat Paints: VOC content of not more than 150 g/L.
9. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
10. Primers, Sealers, and Undercoaters: VOC content of not more than 200 g/L.
11. Dry-Fog Coatings: VOC content of not more than 400 g/L.
12. Zinc-Rich Industrial Maintenance Primers: VOC content of not more than 340 g/L.
13. Pre-Treatment Wash Primers: VOC content of not more than 420 g/L.

D. Chemical Components of Field-Applied Interior Paints and Coatings: Provide topcoat paints and anti-corrosive and anti-rust paints applied to ferrous metals that comply with the following chemical restrictions; these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Aromatic Compounds: Paints and coatings shall not contain more than 1.0 percent by weight of total aromatic compounds (hydrocarbon compounds containing one or more benzene rings).
2. Restricted Components: Paints and coatings shall not contain any of the following:
   a. Acrolein.
   b. Acrylonitrile.
   c. Antimony.
   d. Benzene.
   e. Butyl benzyl phthalate.
   f. Cadmium.
   g. Di (2-ethylhexyl) phthalate.
   h. Di-n-buty l phthalate.
   i. Di-n-octyl phthalate.
   j. 1,2-dichlorobenzene.
   k. Diethyl phthalate.
   l. Dimethyl phthalate.
   m. Ethylbenzene.
   n. Formaldehyde.
   o. Hexavalent chromium.
   p. Isophorone.
   q. Lead.
   r. Mercury.
   s. Methyl ethyl ketone.
   t. Methyl isobutyl ketone.
   u. Methylene chloride.
   v. Naphthalene.
w. Toluene (methylbenzene).
x. 1,1,1-trichloroethane.
y. Vinyl chloride.

2.3 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.
   1. VOC Content: E Range of E2.
   2. Environmental Performance Rating: EPR 1.

2.4 METAL PRIMERS

A. Waterborne Galvanized-Metal Primer: MPI #134.
   1. VOC Content: E Range of E1.
   2. Environmental Performance Rating: EPR 1.

2.5 INTERIOR PAINTS

A. Type and Color: See Room Finish Plan.

2.6 EQUIPMENT

A. Provide all brushes, rollers, ladders, scaffolding and other equipment of any kind to properly execute each type of work.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
   1. Concrete: 12 percent.
   2. Gypsum Board: 12 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.
   1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

E. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
   1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.
3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Comply with manufacturer’s written instructions and recommendations in “MPI Architectural Painting Specification Manual.”

C. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer’s written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and re-prime.
2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
   a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
   b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer’s written instructions.
   c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

E. Gypsum Board: Fill minor irregularities with patching material and sand to smooth level surfaces taking care not to raise nap of paper.

F. Material Preparation: Mix and prepare paint materials according to manufacturer’s written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

G. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer’s written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, non-specular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Sand lightly between each succeeding enamel or varnish coat.

B. Provide adequate forced ventilation of enclosed areas for curing of installed materials, to disperse humidity and to prevent hazardous accumulations of dust, fumes, vapors or gases.

C. Do no interior work until building is properly enclosed.

D. Do work under adequate illumination and dust-free conditions.

1. Apply paint by brush, roller or spray methods except where particular method will produce unsatisfactory results. Where spray method is used on concrete block, follow with roller to work paint into voids.

E. Materials.

1. Do not open containers until required for use.
2. Stir materials thoroughly and keep at uniform consistency during application.

F. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
2. Omit primer over metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.

G. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturer for material and texture required.

H. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.

I. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.

J. Mechanical items to be painted include, but are not limited to, the following:
1. Uninsulated metal piping.
2. Uninsulated plastic piping.
3. Pipe hangers and supports.
4. Tanks that do not have factory-applied final finishes.
5. Visible portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets.
6. Duct, equipment, and pipe insulation having "all-service jacket" or other paintable jacket material.
7. Mechanical equipment that is indicated to have a factory-primed finish for field painting.

K. Electrical items to be painted include, but are not limited to, the following:
   1. Switchgear.
   2. Panel boards.
   3. Electrical equipment that is indicated to have a factory-primed finish for field painting.

L. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.

M. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

N. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
   1. Provide satin finish for final coats.

O. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.

P. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 COLOR SEPARATION

A. Typically one wall color will be used per room. Ceilings generally will be different color than walls. Finished closets will usually be same as adjoining rooms.

B. Job painted metal items such as diffusers, grilles and registers will generally be same color as adjacent surfaces.

C. Surfaces in unfinished areas. Paint all woodwork, doors and metal frames, convectors, ladders, railings, gratings and the like in unfinished areas.

3.5 CLEANING

A. During the progress of this work, remove from the site all discarded paint materials, rubbish, cans and rags at the end of each work day.

B. Upon completion of painting work, clean window glass and other paint-spattered surfaces. Remove spattered paint by proper methods of washing and scraping, using care not to scratch or otherwise damage finished surfaces.
3.6 PROTECTION

A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
   1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.3 PAINT SCHEDULE

A. All interior systems are defined by Benjamin Moore paints. Comparable products by other listed manufacturers are acceptable.

B. In addition to obvious surfaces, the following do not require painting or finishing.
   1. Do not include painting when factory-finishing or installer-finishing is specified for such items as (but not limited to) metal toilet enclosures, acoustic material, finished mechanical and electrical equipment including light fixtures, switchgear and distribution cabinets.
   2. Painting is not required on surfaces such as walls or ceilings in concealed areas and generally inaccessible areas, furred areas, utility tunnels, pipe spaces, duct shafts and elevator shafts.
   3. Metal surfaces of anodized aluminum, stainless steel, chromium plate, copper, bronze and similar finished materials will not require finish painting, unless otherwise indicated.
   4. Moving parts of operating units, mechanical and electrical parts, such as valve and damper operators, linkages, sinkages, sensing devices, motor and fan shafts will not require finish painting, unless otherwise indicated.
   5. Do not paint over any code-required labels, such as Underwriter's Laboratories and factory Mutual, or any equipment identification, performance rating, name or nomenclature plate.
   6. N/A indicates system not applicable to this project.

C. Walls and Ceilings
   1. Paint all rooms listed on Floor Finish Plan. In unscheduled areas, use paint type to match existing. Paint patched walls from 90 degree corner and patched ceilings complete.
   2. Do not apply next coat until previous is thoroughly dry.
   3. Provide final coat which is solid and even in color, free from runs, laps, sags, brush marks, air bubbles and excessive roller stipple and worked into crevices, joints and similar areas.

D. Electrical Panel Box Covers and Doors
   1. Remove, paint and reinstall after paint is dry.

E. Other New Unfinished and Primed Surfaces
   1. Provided specified finish on exposed surfaces. This includes prime coated mechanical units, piping, pipe covering, conduit, and interior duct surfaces visible behind grilles.

F. Gypsum Board: Provide the following finish systems over interior gypsum board surfaces:
   1. Institutional Low-Odor/VOC Latex System:
      c. Topcoat: Benjamin Moore Ultra Spec 500 Interior Flat Finish 536.
G. Ferrous Metal Substrates: (Steel)

H. Concrete Substrates, Traffic Surfaces:
   1. Water-Based Clear Sealer System: MPI INT 3.2G.

I. High-Performance Paint for Steel (See Drawings for locations):
   1. Top Coat: Aliphatic acrylic polyurethane at 2.0 – 3.0 mils dry film thickness.

END OF SECTION 09 9123
SECTION 10 1400 - SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Building Address.
   2. Building Name.
   3. Room Signage.
   5. Parking Lot Accessible Stall Signage.

1.2 DEFINITIONS


1.3 SUBMITTALS

A. Section 01 3300 – Submittal Procedures: Submittal procedures.
B. Product Data: For each type of product indicated.
C. Shop Drawings: Include plans, elevations, and large-scale sections of typical members and other components. Show mounting methods, grounds, mounting heights, layout, spacing, reinforcement, accessories, and installation details.
D. Samples: For each sign type and for each color and texture required.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with applicable provisions of the ADA-ABA Accessibility Guidelines; the International Building Code, Chapter 11 "Accessibility"; and the Wisconsin Administrative Code Chapter SPS 362.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M, of alloy and temper recommended by sign manufacturer for casting process used and for use and finish indicated.
B. Aluminum Sheet: ASTM B 209 (ASTM B 209M0, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 6063-T5.
C. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 6063-T5.
D. Plastic Laminate: High-pressure laminate engraving stock with face and core in contrasting colors.

2.2 SIGNS

A. Building Address: Cast aluminum dimensional characters.
   1. Finishes and Colors: As selected by Architect from manufacturer's full range.
   2. Font Size: Coordinate with Architect.
   3. Location: As shown on Drawings.

B. Extruded Framed Panel for Building Name: Extruded aluminum frames with extruded aluminum panels with extruded aluminum characters chemically welded to faces of panel.
   1. Finishes and Colors: As selected by Architect from manufacturer's full range.
   2. Font Size: To be determined.
   3. Font Style: Coordinate with Owner.
   4. Location: As shown on Drawings.

C. Room Signage: Acrylic/plastic laminated.
   1. Provide one for each room so named on the project drawings (e.g. Conference Room, Equipment Room, Mechanical Room.) Verify all signage with Owner prior to ordering.
   2. Font Size: Coordinate with Owner.

D. Barrier Free Identification:
   1. 10” x 10” plastic laminated sign bearing the international barrier free symbol at each accessible entrance.
   2. 8” x 8” plastic laminated sign bearing the international barrier free symbol at restroom doors.
   3. Tactile and Braille Signage: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and ICC/ANSI A 117.1. Text shall be accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape. Raised-copy thickness shall be not less than 1/32 inch.

E. Exterior Parking Lot ADA Signs: Provide enameled steel signs and supports per Wisconsin Department of Transportation standards.

2.3 ACCESSORIES

A. Anchors and Inserts: Provide nonferrous-metal or hot-dip galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion-bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate signs where indicated or directed by Architect. Install signs level, plumb, and at heights indicated, with sign surfaces free from distortion and other defects in appearance. Comply with manufacturer's written instructions.

B. Install room identification signs at 5 feet from centerline of signs to finished floor.
C. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.

1. Mechanical Fasteners: Use nonremovable mechanical fasteners placed through predrilled holes. Attach signs with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.
2. Signs Mounted on Glass: Provide matching opaque plate on opposite side of glass to conceal mounting materials.
3. Projected Mounting: Mount characters at projection distance from wall surface indicated.

D. Parking Lot Accessible Stall Signage:

1. Install accessible parking signs; locations and heights to meet regulatory requirements under Quality Assurance and Wisconsin Department of Transportation standards.

END OF SECTION 10 1400
SECTION 10 2113 – TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes steel units as follows:
   1. Toilet Enclosures: Overhead braced and floor anchored.

B. Related Sections include the following:
   1. Division 06 Section “Rough Carpentry” for blocking.
   2. Division 10 "Toilet and Bath Accessories" for toilet tissue dispensers, grab bars, and similar accessories.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   1. Show locations of cutouts for compartment-mounted toilet accessories.

C. Samples for each type of toilet compartment material indicated.

1.3 QUALITY ASSURANCE


B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings or applicable testing agency.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board’s “Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities,” ICC/ANSI A117.1 and State of Wisconsin amendments for toilet compartments designated as accessible.

1.4 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication and indicate measurements on Shop Drawings.
   1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating toilet compartments without field measurements. Coordinate wall,
floor, ceilings, and other contiguous construction to ensure that actual dimensions correspond to established dimensions.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.
   1. Electrolytically Zinc Coated: ASTM A 879/A 879M, 01Z (03G).

2.2 STEEL UNITS

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. All American Metal Corporation.
   4. Flush Metal Partition Corp.
   5. General Partitions Mfg. Corp.
   6. Metpar Corp.
   7. Approved Equal.

B. Toilet Enclosure Style: Overhead braced and floor anchored.

C. Urinal-Screen Style: Wall hung.

D. Door, Panel, and Pilaster Construction: Seamless, metal facing sheets pressure laminated to core material; with continuous, interlocking molding strip or lapped-and-formed edge closures; corners secured by welding or clips and exposed welds ground smooth. Exposed surfaces shall be free of pitting, seam marks, roller marks, stains, discolorations, telegraphing of core material, or other imperfections.
   1. Core Material: Manufacturer’s standard sound-deadening honeycomb of resin-impregnated kraft paper in thickness required to provide finished thickness of 1 inch for doors and panels and 1-1/4 inches for pilasters.
   2. Grab-Bar Reinforcement: Provide concealed internal reinforcement for grab bars mounted on units.
   3. Tapping Reinforcement: Provide concealed reinforcement for tapping (threading) at locations where machine screws are used for attaching items to units.

E. Urinal-Screen Construction:
   1. Flat-Panel Urinal Screen: Matching panel construction.
   2. Integral-Flange, Wall-Hung Urinal Screen: Similar to panel construction, with integral full-height flanges for wall attachment, and maximum 1-1/4 inches thick.

F. Facing Sheets and Closures: Hot-dip galvanized steel sheet with nominal base-metal (uncoated) thicknesses standard with manufacturer.

G. Pilaster Shoes and Sleeves (Caps): Stainless-steel sheet, not less than 3 inches high, finished to match hardware.
H. Urinal-Screen Post: Manufacturer’s standard post design of material matching the thickness and construction of pilaster; with shoe and sleeve (cap) matching that on the pilaster.

I. Brackets (Fittings):
   1. Full-Height (Continuous) Type: Heavy-duty stainless steel.

J. Steel-Sheet Finish: Manufacturer’s standard baked-on finish, with one color in each room.
   1. Color and Pattern: As selected by Architect from manufacturer’s full range.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer’s standard design, heavy-duty, tamper-resistant operating hardware and accessories.
   1. Material: Chrome-plated, nonferrous, cast zinc alloy (zamac) or clear anodized aluminum.
   2. Hinges: Manufacturer’s standard paired, self-closing type that can be adjusted to hold doors open at any angle up to 90 degrees.
   3. Latch and Keeper: Manufacturer’s standard latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements of authorities having jurisdiction for accessibility at compartments designated as accessible.
   4. Coat Hook: Manufacturer’s standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
   5. Door Bumper: Manufacturer’s standard rubber-tipped bumper at out-swinging doors.
   6. Door Pull: Manufacturer’s standard unit at out-swinging doors that complies with regulatory requirements of authorities having jurisdiction for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer’s standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer’s standard finish.

C. Anchorages and Fasteners: Manufacturer’s standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match hardware, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use hot-dip galvanized or other rust-resistant, protective-coated steel.

2.4 FABRICATION

A. Overhead-Braced Units: Provide manufacturer’s standard corrosion-resistant supports, leveling mechanism, fasteners, and anchors at pilasters to suit floor conditions. Make provisions for setting and securing continuous head rail at top of each pilaster. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Floor-Anchored Units: Provide manufacturer’s standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.
C. Urinal-Screen Posts: Provide manufacturer’s standard corrosion-resistant anchoring assemblies with leveling adjustment at tops and bottoms of posts. Provides shoes and sleeves (caps) at posts to conceal anchorage.

D. Door Size and Swings: Unless otherwise indicated, provide 24-inch wide in-swinging doors for standard toilet compartments and 36-inch wide out-swinging doors with a minimum 32-inch wide clear opening for compartments indicated to be accessible.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer’s written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer’s recommended anchoring devices.

B. Clearances: Maximum 1/2 inch between pilasters and panels; 1 inch between panels and walls.

C. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Secure continuous head rail to each pilaster with not less than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

D. Stirrup-Brackets: Secure panels to walls and to pilasters with no fewer than two brackets attached near top and bottom of panel. Locate wall brackets so holes for wall anchors occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.

E. Wall-Hung Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb and to resist lateral impact.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to manufacturer’s written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 2113
SECTION 10 2800 – TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Public-use washroom accessories.
   2. Custodial accessories.

B. Related Sections include the following:
   1. Division 08 Section "Mirrors" for mirrors.

1.2 REFERENCES

A. All work of this section shall be in strict accordance with Wisconsin Administrative Code Chapter SPS 362, ICC/ANSI A117.1, the International Building Code, and the ADA-ABA Accessibility Guidelines.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Schedule: Located on indicating types, quantities, sizes, and installation locations by room of each accessory required. Identify locations using room designations indicated on Drawings.

1.4 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design: Products manufactured by Bobrick Washroom Equipment. Subject to compliance with requirements, provide the named product or a comparable product by one of the following. Comparable products must be approved by Architect.

   1. A & J Washroom Accessories, Inc.
   2. American Specialties, Inc.
   5. General Accessory Manufacturing Co. (GAMCO).
   6. Taymor Industries.
   7. Approved Equal.
2.2 TOILET AND BATH ACCESSORIES

A. Double Toilet Tissue (Roll) Dispenser:
   1. Bright-polished, chrome-plated steel.
   2. Self-locking mechanism.
   3. Surface-mounted; vandal resistant.

B. Paper Towel Dispenser with Waste Receptacle:
   1. Type 304 stainless steel.
   2. Semi-recessed.
   3. Lockset: Tumbler type.

C. Soap Dispenser:
   1. Type 304 stainless steel with satin finish.
   2. Surface-mounted.
   3. Valve operates with one hand, without tight grasping, pinching, or twisting of the wrist, and with less than 5 pounds of force.

D. Grab Bars:
   1. Type 304 satin-finish stainless steel tubing.
   2. 1-1/4-inch diameter.
   3. Configurations and Lengths: As indicated on Drawings.

E. Sanitary Napkin Disposal Unit:
   1. Type 304 stainless steel with satin finish.
   3. Door or Cover: Self-closing disposal-opening cover and hinged face panel with tumbler lockset.

F. Sanitary Napkin Dispenser:
   1. Type 304 stainless steel with satin finish.
   2. Tumbler lock.
   3. Impact-resistant coin mechanism.

G. Shower Curtain Rod: One inch (1") diameter rod with permanent type wall anchors to match.

H. Shower Curtain Liner: Waterproof, solid white; include hooks.

I. Baby Changing Station:
   1. Koala Kare Products, KB100-ST horizontal recessed mounted with stainless steel flange baby changing station, or approved equal.

2.6 CUSTODIAL ACCESSORIES

A. Mop and Broom Holder: Shelf with mop and broom holder.
   1. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
2.7 FABRICATION

A. Keys: Provide universal keys for internal access to accessories for servicing and re-supplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install grab bars to withstand a downward load of at least 250 lbf when tested according to method in ASTM F446. Provide solid blocking in wall framing.

C. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items. Remove temporary labels and protective coatings.

D. Clean and polish exposed surfaces to manufacturer’s written recommendations.

END OF SECTION 10 2800
SECTION 10 4416 – FIRE EXTINGUISHERS, CABINETS AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY
A. This Section includes the following:
   1. Fire Extinguishers.
   2. Cabinets.

1.2 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.
C. Samples: For each exposed product and for each color and texture specified.
D. Operation and maintenance data.
E. Warranty: Sample of special warranty.

1.3 QUALITY ASSURANCE
A. Fire-Rated, Fire Protection Cabinets: Listed and labeled to comply with requirements in ASTM E 814 for fire-resistance rating of walls where they are installed.
B. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
C. Coordinate sizes and locations of fire protection cabinets with wall depths.
D. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, “Portable Fire Extinguishers.”
E. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.
F. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

1.4 WARRANTY
A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure of hydrostatic test according to NFPA 10.
      b. Faulty operation of valves or release levers.
   2. Warranty Period: Six (6) years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 MATERIALS

A. Manufacturer’s standard materials.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Larsen’s Manufacturing Company.
   b. Or approved equal.

2. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B and bar coding for documenting fire extinguisher location, inspections, maintenance, and recharging.

B. Multipurpose Dry-Chemical Type: UL-rated, dry chemical in manufacturer’s standard enamel container.

C. Mounting Brackets: Manufacturer’s standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red-baked enamel finish.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Amerex Corporation.
   b. Badger Fire Protection; a Kidde company.
   d. Larsen’s Manufacturing Company.
   e. Potter Roemer, LLC.
   f. Or approved equal.

D. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words “FIRE EXTINGUISHER” in red letter decals applied to mounting surface.

2.3 FIRE PROTECTION CABINETS

A. Cabinet Type: Suitable for fire extinguisher.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Larson 2409, full glass door.
   b. Or approved equal.

B. Cabinet Construction: 1-hour fire rated where required.

1. Fire-Rated Cabinets: Construct fire-rated cabinets with double walls fabricated from 0.0428-inch-thick, cold-rolled steel sheet lined with minimum 5/8-inch-thick fire-barrier material. Provide factory-drilled mounting holes.
C. Semi-Recessed Cabinet: Cabinet box partially recessed in walls of sufficient depth to suit style of trim indicated; with one-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

D. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.

E. Fire Protection Cabinets: Provide manufacturer’s standard box (tub), with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated. Miter and weld joints and grind smooth.

F. Cabinet Material: Steel sheet.

G. Door Material: Steel sheet.

H. Door Style: Fully glazed, frameless, backless, acrylic panel.

I. Door Glazing: Clear float glass.

J. Door Hardware: Manufacturer’s standard door-operating hardware of proper type for cabinet type and door material and style indicated.

K. Finishes:
   1. Manufacturer’s standard baked-enamel paint for the following:
      a. Exterior of cabinet and door except for those surfaces indicated to receive another finish.
      b. Interior of cabinet and door.
   2. Steel: Baked enamel or powder coat.
      a. Color and Gloss: As selected by Architect from manufacturer’s full range.

2.4 ACCESSORIES

A. Mounting Brackets: Manufacturer’s standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

B. Break-Glass Strike: Manufacturer’s standard metal strike, complete with chain and mounting clip, secured to cabinet.

C. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.

D. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
   1. Identify fire extinguishers in fire protection cabinets with the words “FIRE EXTINGUISHER.”
      a. Location: Applied to cabinet door.
      b. Application Process: Pressure-sensitive vinyl letters
      c. Lettering Color: Red.
      d. Orientation: Vertical.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Examine walls and partitions for suitable framing depth and blocking where semi-recessed cabinets will be installed and prepare recesses as required by type and size of cabinet and trim style.
B. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

C. Install fire protection cabinets in locations and at mounting heights indicated.

D. Fire Protection Cabinets: Fasten cabinets to structure square and plumb.

E. Adjust fire protection cabinet doors to operate easily and without binding. Verify that integral locking devices operate properly.

F. Mount fire extinguishers in cabinets or on wall brackets so the top of the extinguisher is not more than 4 feet above the floor.

G. Securely fasten mounting brackets and fire extinguisher cabinets to structure, square and plumb.

H. Identification: Apply vinyl lettering at locations indicated.

I. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

J. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 4416
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1.2 SUBMITTALS

A. Product data: For each type of product indicated.
B. Shop Drawings: Include plans, elevations, sections, details, attachments to other work, and locker identification system and numbering sequence.
C. Samples: For units with factory-applied color finishes.
D. Sample warranties.
E. Maintenance data.

1.3 QUALITY ASSURANCE

A. Uniformity and Single Manufacturer Requirements: Provide each type of metal locker as produced by a single manufacturer, including necessary mounting accessories, fittings, and fastenings.
B. Installer Qualifications: Lockers to be installed by an experienced agent of the manufacturer.
C. Preinstallation Conference: Conduct conference at Project site.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packing and Shipping: Do not deliver metal lockers until building is enclosed and ready for locker installation.
B. Storage and Protection: Protect materials from damage during delivery, handling, storage, and installation.

1.5 WARRANTY

A. Locker manufacturer shall warrant the locker for the lifetime use of the original purchaser from date of shipment. Warranty shall include all defects in material and workmanship, excluding finish, vandalism, and improper installation.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines, ICC/ANSI A117.1, and State of Wisconsin accessibility requirements.

2.2 METAL LOCKERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers. Manufacturer and product must be approved by Owner.

1. Art Metal Products.
2. General Storage Systems Ltd.
3. Hadrian Manufacturing, Inc.
4. Approved Equal.

B. Doors: One piece; fabricated from 0.060-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Doors less than 12 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
2. Doors for box lockers less than 15 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
3. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
4. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch nominal-thickness steel sheet; welded to inner face of doors.
5. Door Style: Vented panel as follows:
   a. Concealed Vents: Slotted perforations in top and bottom horizontal door return flanges.

C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch nominal thickness, with single bend at sides.
2. Backs and Sides: 0.024-inch nominal thickness, with full-height, double-flanged connections.
3. Shelves: 0.024-inch nominal thickness, with double bend at front and single bend at sides and back.

D. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

E. Hinges:

1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches high. Provide no fewer than three hinges for each door more than 42 inches high.
2. Continuous Hinges: Manufacturer's standard, steel, full height.
3. Hinges: Manufacturer's standard, steel, continuous or knuckle type.

F. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.
1. **Multipoint Latching**: Finger-lift latch control designed for use with built-in combination locks, built-in key locks, or padlocks; positive automatic latching and prelocking.
   
a. **Latch Hooks**: Equip doors 48 inches and higher with three latch hooks and doors less than 48 inches high with two latch hooks; fabricated from 0.105-inch nominal-thickness steel sheet; welded or riveted to full-height door strikes; with resilient silencer on each latch hook.
   
b. **Latching Mechanism**: Manufacturer's standard, rattle-free latching mechanism.

G. **Locks**: Built-in combination locks.

H. **Hooks**: Manufacturer's standard ball-pointed type hooks, aluminum or steel; zinc plated.

I. **Coat Rods**: Manufacturer's standard.

J. **Legs**: 6 inches high; formed by extending vertical frame members, or fabricated from 0.075-inch nominal-thickness steel sheet; welded to bottom of locker with closed front and end bases.

K. **Continuous Zee Base**: Fabricated from manufacturer's standard thickness, but not less than 0.060-inch nominal-thickness steel sheet.

L. **Continuous Sloping Tops**: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch (0.91-mm) nominal-thickness steel sheet.

M. **Individual Sloping Tops**: Fabricated from 0.024-inch nominal-thickness steel sheet.

N. **Recess Trim**: Fabricated from 0.048-inch nominal-thickness steel sheet.

O. **Filler Panels**: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch nominal-thickness steel sheet.

P. **Boxed End Panels**: Fabricated from 0.060-inch nominal-thickness steel sheet.

Q. **Finished End Panels**: Fabricated from 0.024-inch nominal-thickness steel sheet.

R. **Center Dividers**: Fabricated from 0.024-inch nominal-thickness steel sheet.

S. **Materials**:
   
1. **Cold-Rolled Steel Sheet**: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
   
2. **Metallic-Coated Steel Sheet**: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with A60 (ZF180) zinc-iron, alloy (galvannealed) coating designation.

T. **See Drawings for locations, numbers, and sizes of lockers.**

U. **Finish**: Baked enamel or powder coat.
   
1. **Color**: As selected by Architect from manufacturer’s full range.

2.3 **LOCKS**

A. **Built-in Combination Locks**: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key.

2.4 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.

C. Equipment: Provide each locker with an identification plate and the following equipment:

   1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
   2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.
   3. Coat Rods: For each compartment of each locker.

D. Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.

E. Accessible Lockers: Fabricate as follows:

   1. Locate bottom shelf no lower than 15 inches above the floor.
   2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

F. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.

G. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

H. Individual Sloping Tops: Fabricated in width to fit one locker frame in lieu of flat locker tops; with integral back; finished to match lockers. Provide wedge-shaped divider panels between lockers.

I. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practical; finished to match lockers.

J. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

K. Boxed End Panels: Fabricated with 1-inch-wide edge dimension, and designed for concealing fasteners and holes at exposed ends of nonrecessed metal lockers; finished to match lockers.

L. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

M. Center Dividers: Full-depth, vertical partitions between bottom and shelf; finished to match lockers.
PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top of lockers and to floor.
3. Anchor back-to-back metal lockers to floor.

B. Welded Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.

C. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach recess trim to recessed metal lockers with concealed clips.
2. Attach filler panels with concealed fasteners.
3. Attach sloping-top units to metal lockers, with closures at exposed ends.

3.2 EQUIPMENT AND ADJUSTING

A. General Requirements: Upon completion of installation, inspect lockers and adjust for proper door and latching mechanism operation.

3.3 CLEANING

A. General Requirements:

1. Clean interior and exposed exterior surfaces, removing debris, dust, dirt, and foreign substances on exposed surfaces.
2. Touch up scratches and abrasions to match original finish.
3. Polish stainless steel and non-ferrous metal surfaces.
4. Replace locker units that cannot be restored to factory-finish appearance.
5. Use only materials and procedures recommended by locker manufacturer.

END OF SECTION 10 5113
SECTION 10 7516 – GROUND-SET FLAGPOLES

PART 1 - GENERAL

1.1 SUMMARY

   A. Section includes ground-mounted aluminum flagpoles.

1.2 PERFORMANCE REQUIREMENTS

   A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 “Quality Requirements” to design flagpole assemblies.

   B. Structural Performance: Flagpole assemblies, including anchorages and supports, shall withstand the effects of gravity loads, and the following loads and stresses within limits and under conditions indicated according to the following design criteria:

      1. Wind Loads: Determine according to NAAMM FP 1001, "Guide Specifications for Design of Metal Flagpoles" for basic wind speed for Project location.
      2. Base flagpole design on polyester flags of maximum standard size suitable for use with flagpole.

1.3 SUBMITTALS

   A. Product Data: Submit manufacturer’s technical data and installation instructions for each type of flagpole required. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes.

   B. Shop Drawings: Submit Shop Drawings of flagpoles and bases, showing general layout, jointing and complete anchoring and supporting systems.

   C. Delegated Design Submittal: For flagpoles.

   D. Samples: Submit samples of each finished metal for flagpoles and accessories as may be requested.

   E. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

   A. Manufacturing Standards: Provide each flagpole as a complete unit produced by a single manufacturer, including fittings, accessories, bases, and anchorage devices.

   B. Pole Construction: Construct pole and ship to site in one piece, if possible. If more than one piece is necessary, provide snug-fitting, precision joints with self-aligning internal sleeve arrangement for weather-tight hairline field joints.

   C. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Spiral wrap flagpoles with heavy Kraft paper or other protective wrapping and prepare for shipment in hard fiber tube or other protective container.

B. Deliver flagpoles and accessories completely identified for installation procedure. Handle and store flagpoles to prevent damage or soiling.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Acme Flagpole Company.
   2. American Flagpole.
   3. Eder Flag Manufacturing Company, Inc.
   5. Approved Equal.

2.2 FLAGPOLES

A. Exposed Height: 30 feet.

B. Aluminum Flagpoles: Fabricate from seamless extruded tubing complying with ASTM B 241/B 241M, Alloy 6063, having a minimum wall thickness of 3/16 inch, tensile strength of not less than 30,000 psi and a yield point of 25,000 psi. Heat-treat and age-harden after fabrication.
   1. Provide cone tapered aluminum flagpoles.

2.3 FLAGPOLE MOUNTING

A. Provide manufacturer’s standard base system for the type of flagpole installation required.

B. Exposed Height: 30 feet.

C. Base Plate: For anchor-bolt mounting, furnish manufacturer’s standard cast metal shoe base of same material as flagpole. Furnish and install anchor bolts and lighting ground spike as required.

D. Foundation Tube: For ground-set flagpoles, provide 16-gage minimum galvanized corrugated steel tube, or 12 gage rolled steel tube, sized to suit flagpole and installation. Furnish complete with welded steel bottom base and support plate, lightning ground spike, and steel centering wedges, all welded construction. Provide loose hardwood wedges at top for plumbing pole after erection. Galvanized steel parts after assembly, including foundation tube.

E. Sleeve for Aluminum Flagpole: Fiberglass or PVC pipe foundation sleeve, made to fit flagpole, for casting into concrete foundation.
2.4 SHAFT FINISH

A. Aluminum: Fine, directional, mechanical satin polish (NAAMM-M32), finished as follows:
   1. Buff and seal aluminum surfaces with clear, hardcoat wax.

2.5 FITTINGS

A. Finial Ball: Manufacturer's standard flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter. Fabricate from 0.063-inch spun aluminum, finished to match flagpole.

B. Internal Halyard, Winch System: Manually operated winch with control stop device and removable handle, stainless-steel cable halyard, and concealed revolving truck assembly with plastic-coated counterweight and sling. Provide flush access door secured with cylinder lock. Finish truck assembly to match flagpole.

2.6 MISCELLANEOUS MATERIALS


B. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

C. Sand: ASTM C 33, fine aggregate.

D. Elastomeric Joint Sealant: Joint sealant complying with requirements in Division 07 Section "Joint Sealants."

2.7 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

PART 3 - EXECUTION

3.1 FLAGPOLE INSTALLATION

A. General: Install flagpoles where shown and according to Shop Drawings and manufacturer's written instructions.
   1. Paint portions of ground-set flagpole below grade with a heavy coat of bituminous paint.

B. Excavation: Excavate for foundation concrete to neat clean lines in undisturbed soil. Provide forms where required due to unstable soil conditions. Remove wood, loose soil, rubbish, and other foreign matter from excavation, and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Concrete: Provide concrete composed of Portland cement, coarse and fine aggregate and water, mixed in proportions to attain 28-day compressive strength of not less than 3,000 psi, complying with ASTM C94.

D. Place concrete immediately after mixing. Perform chuting to avoid segregation of mix. Compact concrete in place by use of vibrators. Moist-cure exposed concrete for not less than seven (7) days, or use a non-staining curing compound in cold weather.
E. Ground Set: Place foundation tube, center, and brace to prevent displacement during concreting. Install flagpole, plumb, in foundation tube. Place tube seated on bottom plate between steel centering wedges and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch layer of elastomeric joint sealant and cover with flashing collar.

F. Baseplate: Cast anchor bolts in concrete foundation. Install baseplate on washers placed over leveling nuts on anchor bolts and adjust until flagpole is plumb. After flagpole is plumb, tighten retaining nuts and fill space under baseplate solidly with nonshrink, nonmetallic grout. Finish exposed grout surfaces smooth and slope 45 degrees away from edges of baseplate.

G. Finish trowel exposed concrete surfaces to smooth, dense surface. Provide positive slope for water runoff to base perimeter.

H. Mounting Brackets and Bases: Anchor brackets and bases securely through to structural support with fasteners as indicated on Shop Drawings.

I. Provide positive lightning ground for each flagpole installation.

END OF SECTION 10 7516
SECTION 11300 - RESIDENTIAL APPLIANCES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following items:
   1. Microwave Ovens.
   2. Refrigerators.

B. Related Sections:
   1. Utilities: Refer to Divisions 22, 23 and 26 for plumbing, HVAC and electrical requirements and connections.

1.2 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer for installation and maintenance of units required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

C. Residential Appliances: Comply with NAECA standards. Dyers must be rated by the manufacturer to allow for vent length, number of elbows required and specific vent hood/termination. Coordinate with the HVAC contractor.

PART 2 - PRODUCTS

2.1 COOKING APPLIANCES

A. Microwave Ovens:
   1. Basis-of-Design Product: Stainless steel, 2.2 cu. ft. capacity, 1,100 watts, countertop microwave manufactured by GE, Profile Series model #PES7227SLSS; or approved equal.

2.2 REFRIGERATION APPLIANCES

A. Refrigerators:
   1. Basis-of-Design Product: Stainless steel, 15.5 cu. ft. top freezer refrigerator manufactured by GE, model #GTS16GSHSS; or approved equal.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Built-In Equipment: Securely anchor units to supporting cabinets and countertops with concealed fasteners. Verify that clearances are adequate for proper functioning and rough openings are completely concealed.

B. Freestanding Equipment: Place units in final locations after finishes have been completed in room. Verify that clearances are adequate to properly operate equipment.

C. Utilities: Coordinate with plumbing and electrical.

END OF SECTION 11 3100
SECTION 12 3530 – CASEWORK & COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:

1. Plastic laminate cabinets and countertops.

1.2 SUBMITTALS

A. Product Data: For high-pressure decorative laminate, adhesive for bonding plastic laminate, cabinet hardware and accessories, and finishing materials and processes.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components. Include countertop layout for each location, details of countertop construction, including backsplash and edge details, and type of core substrate material. Show materials, finishes, filler panels, hardware.

C. Samples:

1. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish, with one (1) sample applied to core material and specified edge material applied to one (1) edge.

1.3 QUALITY ASSURANCE

A. Field Measurements: Verify dimensions of construction to receive countertops by field measurements before fabrication and indicate measurements on Shop Drawings.

B. Fabricator Qualifications: Shop that employs skilled workers who specialize in fabricating products similar to those required for this Project and whose products have a record of successful in-service performance with a minimum of three (3) years documented experience.

C. Quality Standard: Unless otherwise indicated, comply with AWI’s “Manual of Millwork.”

1.4 COORDINATION

A. Coordinate work with plumbing rough-in, electrical rough-in, and installation of associated and adjacent components.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver casework items only when proper storage conditions will be available. Store casework in protected area until ready for installation.

B. Maintain optimum humidity and temperature for conditions after receipt of materials.

C. Store in a manner to allow free circulation of air around all items.

D. Maintain temperature of casework storage areas between 50 to 75 deg F.
1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace cabinets and countertops with material or workmanship defects within specified warranty period.

1. Warranty Period: Ten years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLASTIC LAMINATE CABINETS, COUNTERTOPS AND BACKSPLASHES

A. Plastic Laminate: Particleboard faced with high-pressure decorative laminate complying with NEMA LD3, grades as indicated, or if not indicated, as required by woodwork quality standard.

1. Manufacturers: Subject to compliance with requirements, manufacturers offering high-pressure decorative laminates that may be incorporated into the Work include, but are not limited to, the following:
   a. Formica Corporation.
   b. Nevamar Company, LLC; Decorative Products Div.
   c. Pionite.
   d. Wilsonart International; Div. of Premark International, Inc.

B. Cabinet Hardware and Accessories:

1. General: Provide manufacturer's standard units complying with BHMA A156.9, of type, size, style, material, and finish as selected by Architect from manufacturer's full range.
2. Pulls: Surface mounted decorative pulls.
3. Hinges: Concealed butt hinges.
4. Drawer Guides: Epoxy-coated metal, self-closing drawer guides; designed to prevent rebound when drawers are closed; with nylon-tired, ball-bearing rollers; and complying with BHAMA A156.9, Type B05011 or B05091.

2.2 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln-dried to less than 15 percent moisture content.

B. Adhesives, General: Do not use adhesives that contain urea formaldehyde.

2.3 FABRICATION

A. General: Complete fabrication to maximum extent possible before shipment to Project site. Where necessary for fitting at site, provide allowance for scribing, trimming, and fitting.

1. Shop cut openings to maximum extent possible. Sand edges of cutouts to remove splinters and burrs. Seal edges of openings in countertops with a coat of varnish.

B. Plastic-Laminate Cabinets

1. AWI Type of Cabinet Construction: Flush overlay.
2. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate as follows:
   a. Horizontal Surfaces Other Than Tops: Grade HGS.
   b. Post formed Surfaces: Grade HGP.
c. Vertical Surfaces: Grade HGS.
  d. Edges: Grade HGS.

4. Drawer Sides and Backs: Thermoset decorative panels.
5. Drawer Bottoms: Thermoset decorative panels.
6. Colors, Patterns, and Finishes: As selected by Architect from manufacturer’s standard range.
7. Provide dust panels of 1/4-inch plywood or tempered hardboard above compartments and drawers, unless located directly under tops.

C. Plastic-Laminate Supports/Aprons:

1. AWI Type of Cabinet Construction: Flush overlay.
   a. Horizontal Surfaces Other Than Tops: Grade HGS.
   b. Post formed Surfaces: Grade HGP.
   c. Vertical Surfaces: Grade HGS.
   d. Edges: Grade HGS.
3. Colors, Patterns, and Finishes: As selected by Architect from manufacturer’s standard range.

D. Plastic-Laminate Countertops:

1. High-Pressure Decorative Laminate Grade: HGS.
2. Colors, Patterns, and Finishes: As selected by Architect from manufacturer’s full range.
3. Edge Treatment: Same as laminate cladding on horizontal surfaces.
4. Provide backer sheets on underside of all countertops, regardless of core thickness or unsupported area.
5. Core Material at Sinks: Particleboard made with exterior glue or exterior-grade plywood.
6. Post-rolled leading edge and integral 4-inch backsplash.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify adequacy of backing and support framing.
B. Verify mechanical, electrical, and building items affecting work of this Section are placed and ready to receive this work.

3.2 PREPARATION

A. Provide anchoring devices for installation and embedding.
B. Provide templates and rough-in measurements.

3.3 INSTALLATION OF COUNTERTOPS

A. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.

B. Field Jointing: Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required.
   1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer’s written instructions to exert a constant, heavy-clamping pressure at joints.

C. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.
   1. Install countertops with nor more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
   2. Secure backsplashes to tops with concealed metal brackets at 16 inches o.c. and to walls with adhesive.
   3. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanent elastic sealing compound recommended by countertop material manufacturer.

3.4 ADJUSTING AND CLEANING

A. In-Progress Cleaning: Clean countertops as work progresses. Remove adhesive, grout, mortar, and sealant smears immediately.

B. Repair damaged and defective work.

C. Leave all surfaces clean and without defects.

END OF SECTION
SECTION 13 3419 – METAL BUILDING SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Pre-engineered, shop fabricated structural-steel building framing.
2. Metal wall and standing-seam metal roof panel system, including trim and accessories.
3. Metal soffit panels.
4. Gutters and downspouts.
5. Circular stair shaft enclosure (silo) structure integral with metal building structure.
6. Framing, siding, louvers, soffits and roofs for cupolas.
7. Thermal insulation.
8. Air vapor barrier.
9. Entry canopy silo, complete.
13. Components and materials required for a complete installation.

B. Related Sections Include:

1. Section 05 4000 “Cold-Formed Metal Framing” for circular stair shaft (silo) cold-formed steel wall framing.
2. Section 07 2500 “Weather Barriers” for silo structure.
3. Section 07 7253 “Snow Guards.”
4. Section 08 4113 “Aluminum-Framed Entrances and Storefronts.”

1.2 SYSTEM DESCRIPTION

A. Pre-Engineered Metal Building System:

1. Clear span rigid frame.
2. Primary Framing: Rigid frame of rafter beams and columns and wind bracing.
3. Secondary Framing: Purlins, girts, eave struts, clips, and other items indicated or required.
5. NO logos, signage, manufacturer/company information, etc. shall be on any part of the metal building system.

B. Design Requirements:

1. Design framing and panels in accordance with Metal Building Manufacturer’s Association (MBMA) Manual.
2. Design structural steel members and light gauge steel framing in accordance with AISC specifications.
3. Limit Deflection as follows:
   Primary framing:
   L/180 for roof live and snow load
   H/100 for 70 percent of the service level wind load indicated, except H/240 at office space frames or within the boundary of the circular stair tower.
   Secondary Framing:
L/180 for roof dead load + roof live/snow load, but not less than required to maintain positive drainage for the dead load + roof live/snow load.
L/180 for 10 year wind load on walls and roof
L/180 for snow load on sheathing

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 Building Code.
2. Design wind pressure in accordance with ASCE 7-10.
3. Gravity and wind loads of mechanical and electrical systems, ceiling, roofing, circular stair element, and other elements.
4. Special Loads: Concentrated loads as indicated.

1.3 SUBMITTALS
A. Product Data: For each type of metal building system component. Include description of system components and verify compliance with specified requirements.
B. Shop Drawings: For metal building system components. Include plans, elevations, sections, details, and attachments to other work. Show configuration of panels, trim members, and closures.
C. Samples: For each type of exposed finish required.
D. Delegated-Design Submittal: For metal building systems. Include analysis data and calculations signed and sealed by the qualified professional engineer responsible for their preparation, indicating compliance with performance requirements.
E. State of Wisconsin Plan Review: Manufacturer shall provide Contractor with metal building system plans and delegated-design submittal; this is referred to as a Component Submittal and must be stamped by the professional engineer licensed in the State of Wisconsin who prepared the drawings and calculations. Contractor shall prepare required forms and pay required fees and submit for plan review by the State.
F. Welding certificates.
G. Maintenance data.
H. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE
A. Manufacturer Qualifications: A qualified manufacturer and member of MBMA.
1. Accreditation: Manufacturer’s facility accredited according to the International Accreditation Service’s AC472, “Accreditation Criteria for Inspection Programs for Manufacturers of Metal Building Systems.”
2. Engineering Responsibility: Preparation of comprehensive engineering analysis and Shop Drawings by a qualified professional engineer who is legally qualified to practice in jurisdiction where Project is located.
B. Erector Qualifications: An experienced erector who specializes in erecting and installing work similar in material, design, and extent to that indicated for this Project and who is acceptable to manufacturer.

C. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.3, "Structural Welding Code - Sheet Steel."

D. Structural Steel: Comply with AISC 360, "Specification for Structural Steel Buildings," for design requirements and allowable stresses.

E. Cold-Formed Steel: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stresses.

F. Preinstallation Conference: Conduct conference at Project site.

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; 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.

1.6 WARRANTY

A. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
   1. Finish Warranty Period: 25 years from date of Substantial Completion.

B. Special Weathertightness Warranty for Standing-Seam Metal Roof Panels: Manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that leak or otherwise fail to remain weathertight within specified warranty period.
   1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Steel Building Co., Inc.
   2. Butler Manufacturing Company; a BlueScope Steel company.
   3. Gulf States Manufacturers, Inc.; Division of Magnatrax Corp.
   5. Kirby Building Systems; Division of Magnatrax Corp.
   6. Mesco Building Solutions; Division of NCI Building Systems, L.P.
   7. Metallic Building Corp.
8. Mid-West Steel Building Company; Division of NCI Building Systems, L.P.
10. Vulcan Steel Structures, Inc.
12. Approved equal.

B. All components shall be manufactured by, or approved by, the primary manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: The metal building system, including comprehensive engineering analysis, shall be designed by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Metal building systems shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to procedures in MBMA’s "Metal Building Systems Manual."

1. Design Loads: As indicated on Drawings.

C. Air Infiltration for Metal Roof Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E1680 or ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft (75 Pa).

D. Air Infiltration for Metal Wall Panels: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft (75 Pa).

E. Water Penetration for Metal Roof and Metal Wall Panels: No water penetration when tested according to ASTM E1646 or ASTM E331 for roof panels and when tested according to ASTM E331 for wall panels at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft (137 Pa).

F. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.


2.3 STRUCTURAL STEEL FRAMING

A. Structural Steel: Comply with AISC 360 "Specification for Structural Steel Buildings."

B. Bolted Connections: Comply with RCSC’s "Specification for Structural Joints Using High-Strength Bolts."

C. Cold-Formed Steel: Comply with AISI’s "North American Specification for the Design of Cold-Formed Steel Structural Members" for design requirements and allowable stressed.

D. Primary Framing: Manufacturer's standard primary-framing system, designed to withstand required loads and specified requirements. Primary framing includes transverse and lean-to frames; rafters and rake beams; sidewall, intermediate, end-wall, and corner columns; and wind bracing.
E. End-Wall Framing: Manufacturer's standard primary end-wall framing fabricated for field-bolted assembly.

F. Secondary Framing: Manufacturer's standard secondary framing, including purlins, girts, eave struts, flange bracing, base members, gable angles, clips, headers, jambs, and other miscellaneous structural members. Unless otherwise indicated, fabricate framing from either cold-formed, structural-steel sheet or roll-formed, metallic-coated steel sheet, prepainted with coil coating.

G. Bolts: Provide plain-finish bolts for structural-framing components that are primed or finish painted. Provide zinc-plated or hot-dip galvanized bolts for structural-framing components that are galvanized.

H. Finish: Factory primed. Apply primer immediately after cleaning and pretreating.

2.4 METAL ROOF PANELS

A. Standing-Seam Metal Roof Panels: Roof panels shall be Double-Lok Galvalume Plus (or approved equal) concealed-fastener standing seam metal roofing with all necessary accessories and underlayment.

2.5 METAL WALL PANELS

A. Concealed-Fastener Metal Wall Panels: Wall panels shall be preformed, prefinished metal panels with subgirt framing. Coordinate with overhead doors, swinging and coiling door suppliers and installers, and gutter-downspout supplier-installer.

2.6 METAL SOFFIT PANELS

A. General: Provide factory-formed metal soffit panels designed to be installed by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports, using concealed fasteners and factory-applied sealant in side laps. Include accessories for weathertight installation.

B. Metal Soffit Panels: Match profile and material of metal roof panels.

1. Finish: Match finish and color of metal roof panels.

2.7 GUTTERS AND DOWNSPOUTS

A. Gutters: Galvanized steel sheet, minimum 26-gauge core steel, roll formed.

2. Finish: Match roof fascia:
3. Match profile of trim, complete with end pieces, outlet tubes, and other special pieces as required.
4. Fabricate in minimum 96-inch-long sections.

B. Downspouts: Galvanized steel sheet, minimum 26-gauge core steel, roll formed.

1. Finish: Match wall panels.
2. Fabricate in minimum 10-foot-long sections, complete with formed elbows and offsets.
3. Mounting straps fabricated from same material and finish as gutters.

C. Precast concrete splash blocks.
2.8 THERMAL INSULATION

A. Faced Metal Building Insulation: ASTM C 991, Type II, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch-wide, continuous, vapor-tight edge tabs; with a flame-spread index of 15 or less; where exposed to view.

B. Unfaced Metal Building Insulation: ASTM C 991, Type I, or NAIMA 202, glass-fiber-blanket insulation; 0.5-lb/cu. ft. density; 2-inch-wide, continuous, vapor-tight edge tabs; with a flame-spread index of 25 or less; where concealed.

C. Vapor-Retarder Facing: ASTM C1136, with permeance not greater than 0.02 perm when tested according to ASTM E96/E96M, Desiccant Method.

D. Insulate structural members to eliminate thermal short circuits between structure and roof and wall panels.

E. Minimize heat loss caused by compression of blanket by use of thermal blocks.

2.9 EXTERIOR DOORS AND FRAMES

A. Swinging Personnel Doors and Frames: Metal building system manufacturer’s standard insulated doors and frames; prepared and reinforced at strike and at hinges to receive factory- and field-applied hardware according to BHMA A156 Series.

1. Hardware: Items of hardware not definitely specified herein, but necessary for completion of the Work shall be provided. Such items shall be of type and quality suitable to the service required and comparable to the adjacent hardware. Where size and shape of members is such as to prevent the use of types specified, hardware shall be furnished of suitable types having as nearly as practicable the same operation and quality as the type specified. Sizes shall be adequate for the services required. Include such nuances as strike type, strike lip, raised barrel hinges, mounting brackets, fasteners, shims, and coordination between conflicting products. All doors shall be provided with a stop. Fire-rated openings shall be provided as positive latching and self-closing regardless of what is specified in the sets.

2. Approved Hardware Manufacturers:
   a. Hinges: Hager, Ives, Stanley
   b. Locks and Cylinders: Stanley Best
   c. Closers: LCN
   d. Thresholds and Weather Stripping: NGP, Hager, Reese

3. Provide hardware for each door leaf as follows:
   a. Hinges: BHMA A156.1. Three antifriction-bearing, standard-weight, full-mortise, stainless-steel or bronze, template-type hinges; 4-1/2 by 4-1/2 inches, with nonremovable pin.
   b. Lockset: BHMA A156.2. Mortise, with lever handle type.
   c. Exit Device: BHMA A156.3. Touch- or push-bar type.
   e. Silencers: Pneumatic rubber; three silencers on strike jambs of single door frames and two silencers on heads of double door frames.
   g. Weather Stripping: Vinyl applied to head and jambs, with vinyl sweep at sill.

4. Finishes for Personnel Doors and Frames:
   a. Prime Finish: Factory-apply manufacturer’s standard primer immediately after cleaning and pretreating.
   b. Factory-Applied Paint Finish: Manufacturer’s standard, complying with SDI A250.3 for performance and acceptance criteria.
      1) Color and Gloss: As selected by Architect from manufacturer’s full range.
B. Overhead Sectional Doors (Insulated)

1. Acceptable Manufacturers:
   a. Overhead Door Corporation.
   b. Raynor Garage Doors.
   c. Wayne Dalton Doors.
   d. Approved Equal.

2. Structural Performance: Provide overhead sectional doors capable of withstanding the effects of gravity loads and the following loads and stresses within limits and under conditions indicated according to ASCE/SEI 7, without permanent deformation of door elements and components:
   a. Wind Loads: Uniform pressure (velocity pressure) of 20 lbf/sq. ft., acting inward and outward.

3. Air Infiltration: Maximum rate not more than indicated when tested according to ASTM E283:
   a. Air Infiltration: Maximum rate of 0.08 cfm/sq. ft. at 15 and 25 mph.

4. Thermal Insulation: Insulate interior of door sections with door manufacturer’s standard insulation, with maximum flame-spread and smoke-developed indexes of 75 and 450 respectively, according to ASTM E 84. Enclose insulation completely within steel sections and the interior facing material, with no exposed insulation.

5. Doors:
   a. Operation shall be jack shaft type electric motor. Verify that size of motor is adequate for door size and weight.
   b. Door Sections:
      1) Material: Sections shall be steel sandwich construction, 1-3/4-inch-thick. Exterior metal shall be 25 gauge minimum and interior metal shall be 16 gauge minimum.
      2) Mounting: Mount sections in the door opening using jamb angle mounting. Sections shall overlap the door jambs by one inch (1") on both sides.
      3) Header Seal: Attach seal on top section to prevent airflow above the header.
      4) Section Joint Seals: Interior and exterior skins to be separated by continuous thermal break bead that also forms a complete weather-tight seal along the section joint.
      5) Bottom Seal: Bottom on door to have flexible weather-tight (u-shaped) vinyl seal in an aluminum retainer.
      6) Color: Exterior skins shall have one primer coat and one finish coat. Color as selected by Architect from manufacturer’s standard range.


7. Track:
   a. Material: Track shall be hot-dipped galvanized steel per ASTM A653, fully adjustable for adequate sealing of door to jamb or weather seal.
   b. Mounting: Tracks shall be angle mounted, consisting of a continuous angle extending from the floor to the door header.
   c. Type: Track shall be configured as high-lift (mount tight to structure).

8. Counterbalance System: The door counterbalance system shall be torsion springs with aircraft-type, galvanized wire rope with a minimum safety factor of 5:1

9. Hardware/Accessories:
   a. Hinges and Fixtures: All hinges and accessories shall be galvanized steel.
   b. Rollers shall have hardened steel ball bearings.
   c. Perimeter Seal: Door shall be furnished with a complete weather-stripping system. Weather-stripping shall be replaceable without removing the mounting track hardware, or door hardware.
   d. Manual release cord and lift handle.

10. Locking Devices:
    a. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on single-jamb, operable from inside only.
    b. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

11. Automatic Door Openers:
    a. Provide programmable automatic garage door openers for each sectional door. Verify number required with Owner.
    b. Provide interior side open/close push button.

2.10 WINDOWS

A. Aluminum Windows: Metal building system manufacturer's standard prefinished, low-e insulated glass, thermally broken frames, non-operable windows, with self-flashing mounting fins and as follows:
   1. Type, Performance Class, and Performance Grade: Comply with AAMA/WDMA/CAS 101/I.S.2/A440 and as follows:
      a. Fixed Units: F-LC25.

B. Glazing: Comply with requirements specified in 08 8000 “Glazing.”

2.11 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.
   3. Minimum Dry Film Thickness: 2.0 mils.

B. Wall Panels and Trim: High performance enamel coating, AAMA 620, colors to be selected from manufacturer's full color range.

C. Standing Seam Metal Roof Panels: Galvalume, unless otherwise noted. Color and finish as selected by Architect from manufacturer's full range.

D. Windows: Baked enamel finish, organic coating. Thermosetting, modified-acrylic enamel primer/topcoat system complying with AAMA 2604 except with a minimum dry film thickness of 0.7 mil, medium gloss.

2.12 ACCESSORIES

A. General: Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.
   1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.

B. Roof Panel Accessories: Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

C. Wall Panel Accessories: Provide components required for a complete metal wall panel assembly including copings, fasciae, mullions, sills, corner units, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal wall panels unless otherwise indicated.

D. Flashing and Trim: Zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet, 0.018-inch nominal uncoated steel thickness, prepainted with coil coating; finished to match adjacent metal panels.
E. Roof Ventilators: Gravity type, complete with hardware, flashing, closures, and fittings.

F. Pipe Flashing: Premolded, EPDM pipe collar with flexible aluminum ring bonded to base.

2.13 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate product. Want this section?

B. Testing: Test and inspect shop connections for metal buildings according to the following:
   1. Bolted Connections: Shop-bolted connections shall be tested and inspected according to RCSC’s “Specification for Structural Joints Using ASTM A325 or A490 Bolts.”
   2. Welded Connections: In addition to visual inspections, shop-welded connections shall be tested and inspected according to AWS D1.1/D1.1M and the following inspection procedures, at inspector’s option:
      a. Liquid Penetrant Inspection: ASTM E165.
      b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
      c. Ultrasonic Inspection: ASTM E164.
      d. Radiographic Inspection: ASTM E94.

C. Product will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

2.14 FABRICATION

A. General: Design components and field connections required for erection to permit easy assembly.

   1. Mark each piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and instruction manuals.
   2. Fabricate structural framing to produce clean, smooth cuts and bends. Punch holes of proper size, shape, and location. Members shall be free of cracks, tears, and ruptures.


C. Primary Framing: Shop fabricate framing components to size and section, with baseplates, bearing plates, stiffeners, and other items required for erection welded into place. Cut, form, punch, drill, and weld framing for bolted field assembly.

D. Secondary Framing: Shop fabricate framing components to size and section by roll-forming or break-forming, with baseplates, bearing plates, stiffeners, and other plates required for erection welded into place. Cut, form, punch, drill, and weld secondary framing for bolted field connections to primary framing.

E. Metal Panels: Fabricate and finish metal panels at the factory to greatest extent possible, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements. Comply with indicated profiles and with dimensional and structural requirements.

F. Circular Stair Enclosure: Shop fabrication required. Structural and secondary framing per structural details; siding and roofing per architectural details.
PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Erect metal building according to manufacturer's written instructions and erection drawings.

B. Handle and store all materials to avoid damage and replace any damaged materials.

C. Erector shall observe and follow recommendations of the Metal Building Manufacturer's Association (MBMA) practice and procedures where applicable.

D. All framing members shall be erected plumb, level, or aligned not to exceed a deviation of 1:300.

3.2 ERECTION OF FRAMING SYSTEM

A. Erect metal building system according to AISC and AISI specifications, manufacturer's written erection instructions, and approved Shop Drawings.

B. Do not field cut, drill, or alter structural members without written approval from metal building system manufacturer's professional engineer.

C. Set structural framing accurately in locations and to elevations indicated, according to AISC specifications. Maintain structural stability of frame during erection.


   1. Set plates for structural members on wedges, shims, or setting nuts as required.
   2. Tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
   3. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.

E. Align and adjust structural framing before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact with framing. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

   1. Level and plumb individual members of structure.
   2. Make allowances for difference between temperature at time of erection and mean temperature when structure will be completed and in service.

F. Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and to maintain a level base-line elevation. Moist-cure grout for not less than seven days after placement.

   1. Make field connections using high-strength bolts installed according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for bolt type and joint type specified.

      a. Joint Type: Snug tightened or pretensioned.

G. Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
1. Provide rake or gable purlins with tight-fitting closure channels and fasciae.
2. Locate and space wall girts to suit openings such as doors and windows.
3. Provide supplemental framing at entire perimeter of openings, including doors, louvers, ventilators, and other penetrations of roof and walls.

H. Steel Joists: install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI’s *Standard Specifications and Load Tables for Steel Joists and Joist Girders,* joist manufacturer’s written instructions, and requirements in this Section.

1. Before installation, splice joists delivered to Project site in more than one piece.
2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Bolt joists to supporting steel framework using carbon-steel bolts unless high-strength structural bolts are required by the manufacturer.
5. Comply with RCSC’s "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for high-strength structural bolt installation and tightening requirements.
6. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

I. Bracing: Install bracing in roof and sidewalls where indicated on erection drawings.

1. Tighten rod and cable bracing to avoid sag.
2. Locate interior end-bay bracing only where indicated.

J. Framing for Openings: Provide shapes of proper design and size to reinforce openings and to carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

K. Erection Tolerances: Maintain erection tolerances of structural framing within AISC 303.

3.3 METAL PANEL INSTALLATION, GENERAL

A. General: Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

1. Install in accordance with manufacturer’s written instructions and approved Shop Drawings.
2. Field cut metal panels as required for doors, windows, and other openings. Cut openings as small as possible, neatly to size required, and without damage to adjacent metal panel finishes.
   a. Field cutting of metal panels by torch is not permitted unless approved in writing by manufacturer.
3. Install metal panels perpendicular to structural supports unless otherwise indicated.
4. Flash and seal metal panels with weather closures at perimeter of openings and similar elements. Fasten with self-tapping screws.
5. Locate and space fastenings in uniform vertical and horizontal alignment.
6. Locate metal panel splices over, but not attached to, structural supports with end laps in alignment.
7. Lap metal flashing over metal panels to allow moisture to run over and off the material.

B. Lap-Seam Metal Panels: Install screw fasteners using power tools with controlled torque adjusted to compress EPDM washers tightly without damage to washers, screw threads, or metal panels. Install screws in predrilled holes.
1. Arrange and nest side-lap joints so prevailing winds blow over, not into, lapped joints. Lap ribbed or fluted sheets one full rib corrugation. Apply metal panels and associated items for neat and weather tight enclosure. Avoid "panel creep" or application not true to line.

C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by metal roof panel manufacturer.

D. Joint Sealers: Install gaskets, joint fillers, and sealants where indicated and where required for weatherproof performance of metal panel assemblies. Provide types of gaskets, fillers, and sealants recommended by metal panel manufacturer.
   1. Seal metal panel end laps with double beads of tape or sealant the full width of panel. Seal side joints where recommended by metal panel manufacturer.
   2. Prepare joints and apply sealants to comply with requirements in Division 07 Section "Joint Sealants."

3.4 METAL ROOF PANEL INSTALLATION

A. General: Provide metal roof panels of full length from eave to ridge unless otherwise indicated or restricted by shipping limitations.
   1. Install ridge and hip caps as metal roof panel work proceeds.
   2. Flash and seal metal roof panels with weather closures at eaves and rakes. Fasten with self-tapping screws.

B. Standing-Seam Metal Roof Panels: Fasten metal roof panels to supports with exposed fasteners at each lapped joint, at location and spacing and with fasteners recommended by manufacturer.
   1. Install clips to supports with self-drilling or self-tapping fasteners.
   2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
   3. Snap Joint: Nest standing seams and fasten together by interlocking and completely engaging factory-applied sealant.
   4. Seamed Joint: Crimp standing seams with manufacturer-approved motorized seamer tool so that clip, metal roof panel, and factory-applied sealant are completely engaged.
   5. Rigidly fasten eave end of metal roof panels and allow ridge end free movement due to thermal expansion and contraction. Predrill panels for fasteners.
   6. Provide metal closures at peaks, rake edges, rake walls, and each side of ridge and hip caps.

C. Metal Fascia Panels: Align bottom of metal panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws. Flash and seal metal panels with weather closures along lower panel edges, and at perimeter of all openings.

3.5 METAL WALL PANEL INSTALLATION

A. General: Install metal wall panels in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to girts, extending full height of building, unless otherwise indicated. Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.
   1. Unless otherwise indicated, begin metal panel installation at corners with center of rib lined up with line of framing.
   2. Shim or otherwise plumb substrates receiving metal wall panels.
   3. When two rows of metal panels are required, lap panels 4 inches minimum.
   4. When building height requires two rows of metal panels at gable ends, align lap of gable panels over metal wall panels at eave height.
5. Rigidly fasten base end of metal wall panels and allow eave end free movement due to thermal expansion and contraction. Predrill panels.
6. Flash and seal metal wall panels with weather closures at eaves, rakes, and at perimeter of all openings. Fasten with self-tapping screws.
8. Install flashing and trim as metal wall panel work proceeds.
9. Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete, and elsewhere as indicated; or, if not indicated, as necessary for waterproofing.
10. Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-drilling or self-tapping screws.
11. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.

B. Metal Wall Panels: Install metal wall panels on exterior side of girts. Attach metal wall panels to supports with fasteners as recommended by manufacturer.

3.6 METAL SOFFIT PANEL INSTALLATION

A. Provide metal soffit panels the full width of soffits. Install panels perpendicular to support framing.
B. Flash and seal metal soffit panels with weather closures where panels meet walls and at perimeter of all openings.

3.7 THERMAL INSULATION INSTALLATION

A. General: Install insulation concurrently with metal panel installation, in thickness indicated to cover entire surface, according to manufacturer's written instructions.
   1. Set vapor-retarder-faced units with vapor retarder toward warm side of construction unless otherwise indicated. Do not obstruct ventilation spaces except for firestopping.
   2. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to the surrounding construction to ensure airtight installation.
   3. Install factory-laminated, vapor-retarder-faced blankets straight and true in one-piece lengths, with both sets of facing tabs sealed, to provide a complete vapor retarder.
B. Blanket Roof Insulation: Comply with the following installation method:
   1. Two-Layers-between-Purlin-with-Spacer-Block Installation: Extend insulation and vapor retarder between purlins. Carry vapor-retarder-facing tabs up and over purlin, overlapping adjoining facing of next insulation course and maintaining continuity of retarder. Install layer of filler insulation over first layer to fill space between purlins formed by thermal spacer blocks. Hold in place with bands and crossbands below insulation.
      a. Thermal Spacer Blocks: Where metal roof panels attach directly to purlins, install thermal spacer blocks.
   2. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
C. Blanket Wall Insulation: Extend insulation and vapor retarder over and perpendicular to top flange of secondary framing. Hold in place by metal wall panels fastened to secondary framing.
   1. Retainer Strips: Install retainer strips at each longitudinal insulation joint, straight and taut, nesting with secondary framing to hold insulation in place.
   2. Sound-Absorption Insulation: Where sound-absorption requirement is indicated for metal liner panels, cover insulation with polyethylene film and provide inserts of wire mesh to form acoustical spacer grid.
3.8 EXTERIOR DOOR AND FRAME INSTALLATION

A. General: Install doors and frames plumb, rigid, properly aligned, and securely fastened in place according to manufacturer’s written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each door frame with elastomeric sealant used for metal wall panels.

B. Personnel Doors and Frames: Install doors and frames according to SDI A250.8.

C. Field Glazing: Comply with installation requirements in Division 08, Section “Glazing.”

D. Door Hardware: Mount units at heights indicated in DHI’s “Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames.”
   1. Install surface-mounted items after finishes have been completed on substrates involved.
   2. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
   3. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.
   4. Set thresholds for exterior doors in full bed of butyl-rubber sealant.

3.9 OVERHEAD SECTIONAL DOOR INSTALLATION

A. Install plumb, rigid, properly aligned, and securely fastened in place according to manufacturer’s written instructions.

3.10 WINDOW INSTALLATION

A. General: Install windows plumb, rigid, properly aligned, without warp or rack of frames or sash, and securely fasten in place according to manufacturer’s written instructions. Coordinate installation with wall flashings and other components. Seal perimeter of each window frame with elastomeric sealant used for metal wall panels.
   1. Separate dissimilar materials from sources of corrosion or electrolytic action at points of contact with other materials by complying with requirements specified in AAMA/WDMA/CSA 101/I.S.2/A440.

B. Set sill members in bed of sealant or with gaskets, as indicated, for weathertight construction.

C. Install windows and components to drain condensation, water penetrating joints, and moisture migrating within windows to the exterior.

D. Mount screens directly to frames with tapped screw clips.

3.11 ACCESSORY INSTALLATION

A. General: Install accessories with positive anchorage to building and weather tight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal roof panel assembly, including trim, copings, ridge closures, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
   2. Install components for a complete metal wall panel assembly, including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items.
   3. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with corrosion-resistant coating, by applying rubberized-asphalt underlayment to each contact surface, or by other permanent separation as recommended by manufacturer.
B. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

1. Install exposed flashing and trim that is without excessive oil-canning, buckling, and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and to result in waterproof and weather-resistant performance.

2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

C. Roof Ventilators: Set ventilators complete with necessary hardware, anchors, dampers, weather guards, rain caps, and equipment supports. Mount ventilators on flat level base. Install preformed filler strips at base to seal ventilator to metal roof panels.

D. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to panel as recommended by manufacturer.

E. Gutters and Downspouts:

1. Gutters: Join sections with riveted-and-soldered or lapped-and-sealed joints. Attach gutters to eave with gutter hangers spaced as required for gutter size, but not more than 36 inches o.c. using manufacturer's standard fasteners. Provide end closures and seal water tight with sealant. Provide for thermal expansion.

2. Downspouts: Join sections with 1-1/2-inch telescoping joints. Provide fasteners designed to hold downspouts securely one (1) inch away from walls; locate fasteners at top and bottom and approximately 60 inches o.c. in between. Provide elbows at base of downspouts to direct water away from building.

F. Splash Block: Manufacturer's standard precast concrete splash block. Obtain Architect's approval of splash block design and size before proceeding with work.

3.12 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 13 3419
PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included: Provide plumbing where shown on the Drawings, as specified herein, and as needed for a complete and proper installation including, but not necessarily limited to:

1. Domestic Hot and Cold Water Piping;
2. Drain, Waste, and Vent Systems;
3. Natural Gas Piping Systems;
4. Plumbing Fixtures and Trim;
5. Gas-Fired Water Heaters;
6. Domestic Hot Water Recirculation Pumps;
7. Water Softeners;
8. High Pressure Washers.

B. Work of Other Sections:

1. Openings for new Plumbing work in new construction walls, floors, roof, ceiling, etc. shall be provided by the General Contractor. Location and size of these openings shall be the responsibility of the Plumbing Contractor.
2. Electrical line voltage wiring (110 volts and greater) by the Electrical Contractor. Wiring diagrams shall be furnished to the Electrical Contractor by the Plumbing Contractor.
3. Final gas piping connections for HVAC Equipment by the HVAC Contractor.
4. Roofing, exterior wall and related exterior openings shall be caulked, sealed and patched by the General Contractor.

C. Reference Standards:

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<thead>
<tr>
<th>Acronym</th>
<th>Organization</th>
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<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
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<tr>
<td>ASME</td>
<td>American Society of Mechanical Engineers</td>
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<tr>
<td>ASSE</td>
<td>American Society of Sanitary Engineering</td>
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<tr>
<td>ASTM</td>
<td>American Society of Testing and Material</td>
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<tr>
<td>AWWA</td>
<td>American Waterworks Association</td>
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<td>CISPI</td>
<td>Cast Iron Soil Pipe Institute</td>
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<td>FM</td>
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<td>MCA</td>
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<td>NEC</td>
<td>National Electric Code</td>
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<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
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<td>NFPA</td>
<td>National Fire Protection Association</td>
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<tr>
<td>NSF</td>
<td>National Sanitation Foundation</td>
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<tr>
<td>WQA</td>
<td>Water Quality Association</td>
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1.02 CODES AND PERMITS

A. CODES: The plumbing systems for this facility will meet all codes and standards set forth in the State Wisconsin Plumbing Codes, regulations and those related requirements for plumbing systems in the current local codes, national codes and related, including not limited to the following:

1. Wisconsin Plumbing Code Chapters SPS 80-87;
2. State of Wisconsin Department of Safety and Professional Services(DSPS).

B. SIZING: All water distribution, drain, vent, natural gas and storm piping shall be sized in accordance with the SPS 382, using fixture load values and criteria for systems as shown on the Drawings and set forth herein.

C. Submit one(1) copy of all permits must be furnished to the Owner.
D. Engineer will submit and provide State DSPS approved plumbing plans for this project.

1.03 COORDINATION

A. Cooperate and coordinate with other trades to assure that all systems pertaining to the Plumbing work shall be installed in the best feasible arrangement. Coordinate as required with all other trades to share space in common areas and to provide the maximum of access to each system.

B. Arrange plumbing work in neat, well organized manner with piping and similar services running with primary lines of building construction, and with minimum of 8 foot overhead clearance, where possible.

C. Locate equipment properly to provide easy access, and arrange entire Plumbing Work with adequate access for operation and maintenance.

D. Give right-of-way to piping which must slope for drainage.

E. Where Plumbing work is to connect to existing, the Contractor must field verify all connection points before beginning any rough-in work. Verify gravity flow lines and proper invert elevations required prior to starting piping installation.

F. Coordinate site utility requirements with Site Contractor, along with inverts required to building.

1.05 ELECTRICAL PROVISIONS OF PLUMBING WORK

A. Line Voltage Wiring: The Electrical Contractor is to make all line voltage (100 volts and greater) electrical wiring connections for hookup of the units and systems.

B. Low Voltage Control Wiring: Exposed low voltage (less than 100 volts) temperature control wiring in connection with the Plumbing systems shall be in EMT conduit by the Plumbing Contractor in strict accordance with the applicable sections of the Electrical Specifications. Concealed low-voltage control wiring may be routed to equipment without conduit, unless subject to physical damage.

C. The Plumbing Contractor shall consult with the Electrical Contractor before ordering electrical motors, to ascertain correct electrical current characteristics. Plumbing Contractor shall furnish complete list and location of equipment requiring electrical connections and necessary wiring diagrams to the Electrical Contractor.

1.06 PLUMBING SYSTEM IDENTIFICATION

A. General: Provide adequate marking of plumbing system and control equipment to allow identification and coordination of maintenance activities and maintenance manuals.

   1. Furnish and install adequate marking, tagging and labeling of all accessible and exposed Plumbing equipment, piping and control devices, per ANSI A13.1-1981. Accessible locations shall include all ceiling spaces above accessible ceilings.

B. Equipment: Identify all major Plumbing equipment with plastic-laminate signs of 2" high painted stencils and contrasting background. Provide test of sufficient clarity and lettering to convey adequate information at each location and mount permanently. Identify control equipment by 1-1/2" x 4" plastic laminate nameplates with 1/4" high lettering.

C. Piping: Identify piping once every 30 feet at each branch, at termination of lines, and near valve or equipment connections. Place flow directional arrows at each piping identification. Provide lettering of the appropriate size to convey information on wrap-around signage, adhesive-backed or paint stenciled labels.

D. Valves: Identify all valves with 1-1/2" diameter polished brass tags with stamp-engraved labels or plastic laminate tags. Prefix or color-code tags for each generic piping service. Prepare and submit valve tag schedule, listing location, service and tag description, and incorporate in Instruction Operations Manual.

E. Operational Labels: Where needed for proper or adequate information on operation and maintenance of plumbing systems, provide tags or labels of plasticized or laminated card stock, typewritten to convey the message.

1.07 FLOOR, WALL, ROOF AND CEILING OPENINGS
A. The General Contractor will be required to leave openings in ceiling, floors, walls, roof, partitions, etc., as required to install the Plumbing work specified or shown on the Drawings. The Plumbing Contractor is responsible for correct size and location of his openings. Where penetrations through existing construction are required, they shall be the responsibility of the Plumbing Contractor.

B. Pack annular space between sleeves and pipe with fiberglass insulation and seal with approved caulking materials. Where penetrations occur through fire-rated walls or floors, fill space with fire-resistive insulation similar to high-temperature mineral wool, US Gypsum Thermafiber batts or Cera-blanket FS insulation by Tremco. Seal openings with fire-resistive fire stop caulk/sealant.
   1. Fire-proof plastic piping through fire-rated construction per approved UL listed assembly.

C. Provisions for openings, holes and clearances through walls, floors, ceilings and partitions to be made in advance of construction of such parts of the building.

1.08 CUTTING AND PATCHING

A. General: Refer to Division 1 General Requirements.

B. Perform all cutting and patching required for complete installation of the Plumbing systems, unless specifically noted otherwise. Provide all materials required for patching unless otherwise noted.
   1. All cutting and patching necessary of structural members to install any plumbing work shall not be done without permission, and then only carefully done under the direction of the Architect and General Contractor.

1.09 TRENCHING AND BACKFILLING

A. Trench, excavate and tunnel to place all piping and other related work necessary at the elevations indicated or required, as shown on the Drawings.
   1. Cut bottom of trench to grade, make trench 12” wider than the widest dimension of the pipe.
   2. All pipes shall be laid on a compacted bed of sand 6” deep. Do not lay piping on large stones, rocks or bricks.

B. Backfill in layers and compact sufficiently to prevent settlement. Backfill with damp sand and fine gravel mixture.
   1. Exterior locations shall be backfilled to 12” of grade with sand and fine gravel mixture and the remainder with native compacted topsoil.
   2. Do not start backfill operations until plumbing work has been properly inspected and approved.

1.10 CONCRETE FOR PLUMBING WORK

A. General: Comply with pertinent provisions of Division 1 and Division 3.

B. All concrete work for equipment pads by the Plumbing Contractor.

C. Concrete Equipment Pads: For each piece of floor or ground mounted plumbing equipment as indicated on the Drawings, provide a 4” concrete housekeeping pad at a minimum of 4 inches wider than the full size of the respective equipment’s base. Equipment pads are required for the following equipment:
   1. Water heater & softener/brine tank.
   2. Pipe restraint supports.

1.11 EQUIPMENT ACCESS

A. General: All valves, equipment and accessories shall be installed to permit access to equipment for maintenance, servicing or repairs. This Contractor at no additional cost shall complete relocation of piping, or equipment to accomplish equipment access.
B. **Location:** Provide access doors where equipment is located in chases or inaccessible locations. Access panels shall be furnished by this Contractor and installed by the specific trade responsible for the material in which the access panels are installed.

C. **Construction:** Access doors in fire-rated construction must have UL label. Access doors shall be of size to provide adequate access to equipment concealed in wall, ceiling and furred-in spaces. Milcor or approved equal, 14-gauge steel frame and door, prime-coated, except stainless steel in areas subject to excessive moisture.

### 1.12 INSTRUCTIONS AND MANUALS

A. Upon completion of the installation, but before final acceptance of the system, the Plumbing Contractor shall instruct the Owner on the care and operation of all parts of the Plumbing system.

B. Assemble two (2) complete sets of manufacturer’s printed operating and maintenance instructions for all mechanical equipment and installed under this contract. Prepare in bound copies complete with index tabs. Information must include parts lists, equipment warranties, and wiring diagrams. Submit bound copies to Architect for disbursement.

### 1.13 AS-BUILT DRAWINGS

A. During construction maintain a set of prints showing installed as-built work for the project.

B. Upon completion of construction before final acceptance, provide a set of as-built drawings to the Architect/Engineer.

### PART 2 - PRODUCTS

#### 2.01 DOMESTIC WATER PIPE SCHEDULE

A. **Above Ground Piping:**

1. 2’ and smaller:
   a. Type ‘L’ or ‘M’ hard-annealed copper; cast or wrought copper fittings, ASTM B88; lead-free solder. Mechanically fittings equivalent to ProPress may be used.
   b. Crosslinked Polyethylene(PEXa) plastic piping, ASTM F876 and F877 and installed per ASTM D2774.
   c. PEXa water piping from HDPE multi-port or copper multi-port tees for branch piping.
   d. Provide color coded PEXa hot and cold piping.

2. 2-1/2’ and 3’:
   a. Type ‘L’ or ‘M’ hard-annealed copper; cast or wrought copper fittings, ASTM B88; lead-free solder. Mechanically fittings equivalent to ProPress may be used.

3. 3’ and larger:
   a. Ductile iron pipe; mechanical joints with gaskets.

B. **Below Ground:**

1. 2” and smaller:
   a. Type ‘K’ soft-annealed copper; cast or wrought copper fittings; lead-free solder. Mechanically fittings equivalent to ProPress may be used.
   b. Crosslinked Polyethylene(PEX) plastic piping, ASTM F876 and F877 and installed per ASTM D2774.

2. 2-1/2” and 3”:
   a. Type ‘L’ or ‘M’ hard-annealed copper; cast or wrought copper fittings, ASTM B88; lead-free solder. Mechanically fittings equivalent to ProPress may be used.
   b. Crosslinked Polyethylene(PEX) plastic piping, ASTM F876 and F877 and installed per ASTM D2774.

3. 3’ and larger:
   a. Ductile iron pipe; mechanical or push-on joints with gaskets.
C. **Below Ground**: 3” and Larger:

1. Ductile iron pipe, mechanical joints, thickness Class 52, AWWA C151; with standard thickness cement mortar lining, AWWA C104; ductile iron mechanical joint compact fittings, Class 350, AWWA C153; rubber gasket joints with none-toxic gasket lubricant, AWWA C111.

2. Provide 8 mil tube or sheet polyethylene encasement of iron pipe and pipe fittings, AWWA C105.

3. **Thrust Restraints**: 2500 psi concrete; retainer glands; restrained joint fittings; steel rods, ASTM A575; steel clamps and straps, ASTM A506; steel bolts, ASTM A307; malleable iron rod couplings, ASTM A197; cast iron washers, ASTM A307; bitumastic anti-corrosion coating.

### 2.02 DRAIN, WASTE AND VENT PIPE SCHEDULE

#### A. **Interior Above Ground**:

1. PVC plastic pipe, Schedule 40, Class 12454-B(PVC 112), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

#### B. **Interior Below Ground**:

1. PVC plastic pipe, Schedule 40, Class 12454-B(PVC 112), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

#### C. **Exterior Below Ground**: 15” and Smaller:

1. PVC plastic pipe, Schedule 40, Class 12454-B(PVC 112), ASTM D1785; PVC plastic drain, waste and vent pipe and fittings, ASTM D2665; socket fitting patterns, ASTM D3311; primer, ASTM F656; solvent cement, ASTM D2564.

### 2.03 NATURAL GAS PIPING

#### A. **Interior Above Ground**: 3” and Smaller:


#### B. **Exterior Below Ground**: 3” and Smaller:

1. HDPE Schedule 40: welded fusion fittings.

#### C. **Gas valves**:

1. **3” and smaller**: Ball valve, bronze-body, threaded ends, stainless steel ball, full or conventional port, teflon seat, blowout-proof stem, two-piece construction suitable for 150 psig working pressure, U.L. listed for use as a natural gas shut-off valve.

2. **Gas Pressure Regulators**: (2 lb to 14 oz): Brass construction body with stainless steel spring valve and orifice regulator with vented housing or ventless listed by UL. Maxitrol or equal.

### 2.04 VALVES

#### A. **Check valves**:

1. **3” and smaller**: Bronze, screwed, Y-pattern, 200# WOG, swing check type.

2. **4” and larger**: Flanged, 200# WOG.

#### B. **Ball valves**:
1. **3" and smaller:** Two or three piece, bronze-body, chrome-plated bronze ball, Teflon seat and packing, 400 pig WOG, with stem extensions on insulated piping. Apollo 70-200 series.

### 2.05 VENT FLASHING

A. Where pipes of this Section pass through the roof, flash the opening with seamless 3 lb./sq.ft. lead flashing with 15" x 17" minimum base size, steel reinforced boot and cast iron counterflashing sleeve.

B. **Single Ply Membrane Roofs:** Flash boot of material compatible with roofing membrane and base flange for adhering to membrane.
   1. Stainless steel drawband for securing boot to vent pipe.

### 2.06 PIPE HANGERS

A. **Piping:**
   1. Split ring hangers with supporting rods.
   2. Adjustable clevis.

B. **Multiple or Trapeze Hangers:**
   1. Steel channels with welded spacers and hanger rods.

C. **Vertical Support:**
   1. Steel riser clamp.

D. **Floor Support:**
   1. Painted steel pipe saddle, stand and bolted floor flange.

E. **Copper Pipe Supports:**
   1. All supports, fasteners, clamps, etc. directly connected to copper piping shall be copper-plated or polyvinylchloride(PVC)-coated.
   2. Where steel strut supports are used, provide isolation collar between supports/clamp and copper piping.

F. **Approved Manufacturers:** Fee and Mason, B-line, Grinnell or approved equal.

### 2.07 CLEANOUTS

A. **Exterior:** Smith #4253 with XH cast iron top in concrete areas.

B. **Interior Floors:**
   1. Round nickel-bronze top in finished room floors
   2. Round cast iron top in unfinished room floors.

C. **Finished walls:** Smith #4532 with access plate and screw to match wall color.

D. Provide cleanout plugs of extra heavy bronze

E. **Approved Manufacturers:** Josam, Smith, Wade, Zurn or approved equal.

### 2.08 ACCESS
A. **General:** All piping, conduit and accessories shall be installed to permit access to equipment for maintenance. Any relocation of piping, equipment or accessories required to provide maintenance access shall be accomplished by the Contractor at no additional cost.

A. **Removable Access Plates:** Where only hand access is sufficient for valve access, provide removable plate-type access unit of minimum size which will facilitate required access.

1. Provide units of type, style, design, material and finish appropriate for location and exposure in each instance.
2. In exposed surfaces of occupied spaces provide round plate units, flush floor units and frameless, low-profile wall units, primed-for-paint in painted surfaces and polished chrome or stainless steel finish in other surfaces.

C. **Walls:**

1. Smith #4767 flush wall stainless steel cover plate with screw latch lock in finished tile walls at wet locations.
2. Smith #4760 or #4765 with bonderized prime-coated steel face and screw latch lock in walls of other finished rooms.

D. **Ceilings:**

1. Provide Smith #4765 flush ceiling bonderized prime-coated steel face with screw latch lock.

E. **Floors:**

1. Smith #4910 with aluminum or nickel-bronze non-skid top.

2.09 **WATER HAMMER ARRESTORS**

A. Provide Smith #5000 series or equal, stainless steel or air chambers at each fixture group utilizing a flush valve or fast closing solenoid valve, as sized and recommended by the manufacturer.

B. **Approved Manufacturers:** Joss, PPP, Smith, Wade, Urn or approved equal.

2.10 **HANDICAPPED INSULATION**

A. Where shown on the Drawings or required by governmental agencies having jurisdiction, provide “Truebro” insulation system or approved equal on exposed hot and cold water supply piping, waste tailpiece and trap at lavatories requiring ADA compliance.

2.11 **PIPE INSULATION**

A. **General:** Provide composite piping insulation (insulation, jackets, coverings, sealers, mastics, and adhesives) with ratings not exceeding flame spread of 25 and a smoke developed of 50 in active return air plenums. Ratings in all other areas shall not exceed a flame spread of 25 and a smoke developed of 150 (test method ASTM E-84). Comply with all codes regarding the use of foam insulation.

B. Insulate piping located in interior space, including (but not necessarily limited to) the following services:

1. Interior cold and hot domestic water piping.
2. Horizontal storm water piping.

C. Insulate each piping system with one of the following types and thicknesses of insulation, except as otherwise indicated (Installer's option where more than one type is indicated).

1. **Fibrous Glass:** Minimum density 3 lb./cu.ft., thermal conductivity of not more than 0.23 at 75 degrees F mean temperature, suitable for temperatures to 450 degrees F. Kraft-reinforced, foil-vapor barrier, laminate all-service jacket, factory applied to insulation with a self-sealing pressure sensitive adhesive lap, maximum permeance of 0.02 perms and minimum beach puncture resistance of 50 units.
2. **Elastomeric Insulation:** Closed-cell type, with minimum nominal density of 5.5 lbs./cu.ft., thermal conductivity to not more than 0.27 at 75 degrees F mean temperature, and maximum water vapor transmission of 0.17 perm/inch. The material shall be suitable for a temperature range from 220 degrees F to minus 40 degrees F.

D. **Insulation Installation Schedule:**

<table>
<thead>
<tr>
<th>Service</th>
<th>Pipe Size</th>
<th>Insulation Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Water Piping</td>
<td>Less than 1”</td>
<td>1”</td>
</tr>
<tr>
<td></td>
<td>1 thru 1-1/2”</td>
<td>1”</td>
</tr>
<tr>
<td></td>
<td>1-1/2 thru 4”</td>
<td>1-1/2”</td>
</tr>
<tr>
<td>Cold Water Piping</td>
<td>Less than 1”</td>
<td>1/2”</td>
</tr>
<tr>
<td></td>
<td>1” thru 1-1/2”</td>
<td>1/2”</td>
</tr>
<tr>
<td></td>
<td>1-1/2 thru 4”</td>
<td>1”</td>
</tr>
<tr>
<td>Storm Water Interior Piping</td>
<td>All sizes</td>
<td>1”</td>
</tr>
</tbody>
</table>

2.12 **FIXTURES AND EQUIPMENT**

A. **General:** Provide plumbing fixture, trim, and equipment as shown on the "Fixture and Equipment Schedule" on the Contract Drawings, and as specified herein.

B. All vitreous chinaware and porcelain fixtures shall be select quality.

1. All wastes and supplies for fixtures, except as otherwise specified or required, shall turn back into walls.

C. All trim, except as otherwise specified, shall be constructed of brass. Finish shall be polished chrome, except where concealed (inside cabinets, etc.).

D. All fixtures with non-accessible traps such as bathtubs, showers, floor drains, shall have a completely removable stopper or grate in order to be accessible for cleanout.

E. Stops are to be provided at each fixture. It is the Contractor’s option to install straight or angle type. All stops are shall have a minimum of ½” inlets with flexible riser and loose key handles where exposed to the public.

1. All shower/bath valves are to have integral stops.
2. All loose stops shall be from the same manufacturer.

F. Coordinate installation of floor recessed shower modules with General Contractor for proper ADA curb heights.

2.13 **GAS-FIRED WATER HEATERS**

A. Water heaters shall be designed for condensing operation constructed of seamless stainless 316L for the tank with 90/10 cupronickel primary heat exchanger and 800H stainless steel/cupronickel secondary heat exchanger. Tank shall be insulated with 2” of foam insulation with enclosed plastic jacket. All water fittings shall be constructed of stainless steel. All heaters shall be supplied with factory installed ASME rated temperature and pressure relief valve, low water cutoff, high temperature switch, upper and lower water sensors and condensate trap with neutralizer kit.

1. The heaters shall be suitable for venting with CPVC pipe for a total equivalent distance of 100 feet.
2. The heater shall be factory assembled and tested.
3. The power burner shall be of a design that requires no special calibrations on start up. The heaters shall be approved for 0” clearances to combustibles.

B. The control shall be an integrated solid-state digital controller for temperature and ignition control device with integral diagnostics, LED fault display capability and a digital LCD display of temperature settings.

C. The tanks shall be foam insulated and equipped with ASME rated temperature pressure relief valve. The water heater shall be UL listed and exceed the minimum efficiency requirements of ASHRAE/IES 90.1b-1992.

a. Rated at 95% minimum efficiency.
b. Provide concentric roof flue/combustion air vent for sealed combustion operation.
2.14 DOMESTIC HOT WATER RECIRCULATION PUMPS

A. Horizontal single stage close coupled system lubricated in-line pumps, 125 psig maximum working pressure at operating temperature of 225 deg F continuous. The manufacturer shall certify all pump ratings.

1. Casing: Bronze or stainless steel; flanged suction and discharge connection.
2. Impeller: Bronze, stainless steel or thermoplastic, keyed to the shaft, single suction enclosed type, hydraulically and dynamically balanced.
4. Shaft: Stainless steel or ceramic.
5. Seal: Stainless steel isolating rotor and stator.

B. Motor: Provide pump with impedance protected motor sized for non-overloading over the entire pump curve. Furnish each pump and motor with a nameplate giving the manufacturer's name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current.

C. Approved Manufacturer: Bell and Gossett, Grundfos or approved equal.

2.15 WATER SOFTENERS

A. Control: A factory-mounted and wire cycle controller shall incorporate a water meter demand control system with turbine meter and electronic meter controller with multiported pilot valve to control all steps of automatic regeneration. Water demand controller shall backwash resin based on water volume metered as monitored by microprocessor-based controls including the following functions:

1. Volume of gallons.
2. Hardness display in grains.
3. Totalizing metering.
4. System flow rate in GPM.
5. Adjustable regeneration times.
6. Delayed or immediate regeneration.
7. System diagnostic displays.
8. Calendar day override.

B. Softener Tank: Tank shall be of NSF approved, UL listed, non-corrosive reinforced pressure vessel rated for 150 psig working pressure and 120 deg F, and hydrostatically tested at 50% in excess of the working pressure.

C. Internal Distribution:

1. Upper distributor system shall be of the single point baffle type, constructed of schedule 40 galvanized steel or PVC, non-corrosive materials and fittings.
2. Lower distribution system shall be the hub and radial arm type, PVC constructed with individual fine slotted non-clogging polyethylene strainers arranged for even flow distribution through the resin bed. The distribution system shall be embedded in a single layer sub fill to support the resin bed.

D. Main Operating Valve: The main operating valve shall be an Industrial Automatic Multiport diaphragm type, slow opening and closing, free of water hammer.

1. The diaphragm assembly shall be fully guided on its perimeter when pressure actuated from one position to another to assure a smooth reliable shut-off without sticking.
2. There shall be no contact of dissimilar metals within the valve and no special tools shall be required to service the valve.
3. The main operating valve shall be manufactured by the manufacturer of the softening equipment.
4. Valve shall be equipped with an internal automatic self-adjusting brine injector to draw brine and rinse at a constant rate regardless of water pressure in the range 30 to 100 psi.
5. Single units shall have an internal automatic by-pass of untreated water during regeneration. Valve shall have a soft water sampling cock.
E. **Flow Control:** An automatic flow controller shall be provided to maintain proper backwash and flush rates over wide variations in operating pressures and require no field adjustment.

F. **Exchange Resin:** The ion exchange resin shall be virgin, high capacity sulfonated polystyrene type stable over entire pH range with good resistance to bead fracture from attrition or osmotic shock.

   1. Each cubic foot of resin shall be capable of removing 30,000 grains of hardness as calcium carbonate when regenerated with 15 lbs. of salt.

G. **Brine System:** Provide a single brine measuring and dry salt storage tank with salt platform. Size tank for at least four (4) regenerations at full salting. Brine dosage shall be easily adjusted in the field without piping revision.

   1. Tank shall be constructed of rigid 3/8” thick rotationally molded polyethylene with cover.
   2. The brine tank shall be equipped with a float operated plastic, fitted field serviceable brine valve for automatic control of brine withdrawal and fresh water refill. The brine valve shall provide positive shut-off to prevent air from entering system. High purity pellet type salt is required.

H. **Acceptable Manufacturers:**

   1. Hellenbrand or approved equal.

2.16 **HIGH PRESSURE WASHER**

A. **Manufacturer/Model:** McHenry HEG-3005-0E8G; Hotsy, AaLadin or approved equal.

B. Wall-mounted on angle-iron frame with gas-fired bonnet and remote control station at wash bay.

   1. Rated Flow Rate: 4.8 GPM.
   2. Pressure Output: 3000 psig.
   3. Maximum Temperature: 210 deg F.
   4. Natural Gas Input: 338 MBH @ 14” WC.
   5. Flue: 10” diameter sealed vent with backdraft damper.
   7. Motor HP: 10HP

C. High Pressure Washer vendor shall be responsible to provide a complete installation including all labor and parts for a complete and functioning installation, as well as, coordination with other trades for installation.

2.17 **OTHER MATERIALS**

A. Provide other materials, not specifically described but required for a complete and proper installation, as selected by the Contractor subject to the approval of the Architect.

PART 3 - EXECUTION

3.01 **SURFACE CONDITIONS**

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

3.02 **SITE UTILITIES**

A. Arrange for new services for water, natural gas and sewer connections with the Site Utility Contractor, local utilities or municipal utilities.

B. Owner will pay all fees for new services. Contractor is responsible for all construction permits.

C. Set valve boxes level and plumb centered over valve. Set bottom flange on undisturbed soil or compacted granular backfill. Adjust top section to finished grade.
D. Verify all flow lines to the municipal sewer prior to installing any underground sewer piping. Advise the Engineer/Owner of site conditions or inverts inconsistent with the plumbing layout and proposed flow line prior to proceeding.

3.03 PLUMBING SYSTEM LAYOUT

A. Lay out the plumbing system in careful coordination with the Drawings, determining proper elevations for all components of the system and using only the minimum number of bends to produce a satisfactorily functioning system.

B. Follow the general layout shown on the Drawings in all cases except where other work may interfere.

C. Lay out pipes to fall within partition, wall, or roof cavities, and to not require furring other that as shown on the Drawings.

D. Where work is to connect to existing, Plumbing contractor must field verify all connection points before beginning any rough-in work. Verify all connecting invert elevations and flow lines of new work connected to existing gravity drainage.

3.04 TRENCHING AND BACKFILLING

A. Perform trenching and backfilling associated with the work of this Section in strict accordance with the provisions of Division 2 of these Specifications.

B. Cut bottom of trenches to grade. Make trenches 12" wider than the greatest dimension of the pipe.

C. Bedding and backfilling:
   1. Install piping promptly after trenching. Keep trenches open as short a time as practicable.
   2. Under the building, install pipes on a 6" bed of damp sand. Backfill to bottom of slab with damp sand.
   3. Outside the building, install underground piping on a 6" bed of damp sand. Backfill to within 12" of finish grade with damp sand. Backfill remainder with native topsoil.
   4. Do not backfill until installation has been approved and until Project Record Documents have been properly annotated.

3.05 INSTALLATION OF PIPING AND EQUIPMENT, GENERAL

A. General:
   1. Proceed as rapidly as the building construction will permit.
   2. Thoroughly clean items before installation. Cap pipe openings to exclude dirt until fixtures are installed and final connections have been made.
   3. Cut pipe accurately, and work into place without springing or forcing properly clearing window, doors, and other openings. Excessive cutting or other weakening of the building will not be permitted.
   4. Show no tool marks or threads on exposed plated, polished, or enameled connections from fixtures. Tape all finished surfaces to prevent damage during construction.
   5. Make changes in directions with fittings; make changes in main sizes with eccentric reducing fittings. Unless otherwise noted, install water supply and return piping with straight side of eccentric fittings at top of the pipe.
   6. Run horizontal sanitary piping at a uniform grade of 1/4" per ft., unless otherwise noted. Run horizontal water piping with an adequate pitch upwards in direction of flow to allow complete drainage.
   7. Provide sufficient swing joint, ball joints, expansion loops, and devices necessary for a flexible piping system, whether or not shown on the Drawings.
   8. Support piping independently at pumps, coils, tanks, and similar locations, so that weight of pipe will not be supported by the equipment.
   9. Pipe the drains from pump glands, drip pans, relief valves, air vents, and similar locations, to spill an open sight drain, floor drain, or other acceptable discharge point, and terminate with a plain and unthreaded pipe 6" above the drain.
   10. Securely bolt all equipment, isolators, hangers, and similar items in place.
   11. Support each item independently from other pipes. Do not use wire for hanging or strapping pipes.
   12. Provide complete dielectric isolation between ferrous and non-ferrous metals.
   13. Provide union and shut off valves suitably located to facilitate maintenance and removal of equipment and apparatus.
B. **Equipment access:**

1. Install piping, equipment, and accessories to permit access for maintenance. Relocate items as necessary to provide such access, and without additional cost to the Owner.
2. Provide access doors where valves, motors, or equipment requiring access for maintenance are located in wall or chases or above ceilings. Coordinate location of access doors with other trades as required.

### 3.06 CLEANOUTS

A. Secure the Architect's approval of locations for cleanouts in finished areas prior to installation.

B. Provide cleanouts of same nominal size as the pipes they serve; except where cleanouts are required in pipes 4" and larger provide 4" cleanouts.

C. Make cleanouts accessible. After pressure tests are made and approved, thoroughly graphite the cleanout threads.

### 3.07 VALVES

A. Provide valves in water and gas systems. Locate and arrange so as to give complete regulation of apparatus, equipment, and fixtures.

B. Provide valves in at least the following locations:

1. In branches and/or headers of water piping serving a group of fixtures.
2. On both sides of apparatus and equipment.
3. For shutoff of risers and branch mains.
4. For flushing and sterilizing the system.
5. Where shown on the Drawings.

C. Locate valves for easy accessibility and maintenance.

### 3.08 WATER HAMMER ARRESTORS

A. Provide water hammer arrestors on hot water lines and cold water lines.

1. Install in upright position at all quick closing valves, isolated plumbing fixtures, and supply headers at plumbing fixture groups.
2. Locate and size as specified, locate in accordance with Plumbing and Drainage Institute Standard WH-201.
3. Install water hammer arrestors behind access panels.

### 3.09 BACKFLOW PREVENTION

A. Protect plumbing fixtures, faucets with hose connections, and other equipment having plumbing connection, against possible back siphonage.

B. Arrange for testing of backflow devices as required by the governmental agencies having jurisdiction.

### 3.10 WATER HEATERS

A. Provide piping, unions, valves, thermometers, relief valves, and all necessary hardware.

B. Install relief valves and extend relief piping to above floor drain.

C. Water heaters shall be located such that all controls, relief valves, access holes are accessible for service and replacement without moving heaters.

D. When dual water heater installations call for, water heaters shall be manifolded together with piping to permit equal flow to and from each heater.

E. Set water heaters on 4" high concrete housekeeping pads by General Contractor.
3.11 WATER SOFTENERS

A. Provide field start-up and inspection of softeners by an authorized service representative. Instruct Owner's personnel in the proper operation and maintenance of the softening system.

1. Document setup testing and submit report to Owner.

B. Test water hardness to verify proper working performance. Submit report to A/E.

C. Set softener equipment on 4" high concrete housekeeping pads by General Contractor.

3.12 HIGH PRESSURE WASHER

A. Install high pressure washer where indicated on the Drawings in accordance with manufacturer's recommendations. Locate equipment and arrange plumbing piping to provide access space for servicing all components.

B. Coordinate high pressure washer installation with HVAC and electrical trades for venting and electrical service requirements.

C. Complete installation and demonstrate operation of high pressure washer.

1. Document setup testing and submit report to Owner.

2. Provide Owner training of proper operation for high pressure washer.

3.13 DISINFECTION OF WATER SYSTEMS

A. Disinfect hot and cold water systems.

1. Perform disinfection under the Architect's observation. Notify the Architect at least 48 hours prior to start of the disinfection process.

2. Upon completion of disinfecting, secure and submit the Certificate of Performance, stating system capacity, disinfectant used, time and rate of disinfectant applied, and resultant residuals in ppm at completion.

3. Use disinfectant method approved by the Architect.

B. When disinfection operation is completed, and after final flushing, secure an analysis by a laboratory approved by the Architect, based on water samples from the system, showing test negative for coli-aerogene organisms. Provide a total plate count of less than 100 bacteria per cc, or equal to the control sample.

C. If analysis results are not satisfactory, repeat the disinfection procedures and retest until specified standards are achieved.

3.14 OTHER TESTING AND ADJUSTING

A. Provide personnel and equipment, and arrange for and pay the costs of, all required tests and inspections required by governmental agencies having jurisdiction.

B. Where test show materials or workmanship to be deficient, replace or repair as necessary, and repeat the tests until the specified standards are achieved.

C. Adjust hot water recirculation pump timer and aquastat per Owner's usage schedule.

D. Adjust the system to optimum standards of operation.

END OF SECTION
SECTION 23 2000  
VIBRATION ISOLATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Extent of vibration isolation work required by this section is indicated on drawings and schedules, and/or specified in other Division 15 sections.
B. Types of vibration isolation products specified in this section include the following:
   1. Vibration Isolation Springs.
   2. Flexible Duct Connectors.

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 shall govern work under this section.
B. Specified Elsewhere:
   1. 23 86 00 Ductwork Accessories

1.3 DESIGN CRITERIA
A. Isolate all motor driven mechanical, unless otherwise noted, from the building structure, and from the systems which they serve, to prevent equipment vibrations from being transmitted to the structure.
B. Consider equipment weight distribution to provide uniform deflections.
C. For equipment with variable speed capability, select vibration isolation devices based on the lowest speed.

1.4 SUBMITTALS
A. Submit shop drawings of isolation devices indicating isolation materials, isolator heights both free & operating, isolator dimensions, deflections, and isolation efficiency based on lowest operating speed.

1.5 SUPERVISION AND INSPECTION
A. Vibration isolation manufacturer or his qualified representative to provide supervision to assure correct installation and adjustment of the isolators.
   1. Upon completion of the installation and after the system is put into operation, the manufacturer, or his representative, shall make a final inspection and submit his report to the A/E in writing, certifying the correctness of installation and compliance with the specifications.

PART 2 - PRODUCTS

2.1 MATERIALS
A. All isolation devices shall be designed for the equipment with which they will be used. Materials used shall retain their isolation characteristics for the life of the equipment served. All elastomeric materials shall be industrial grade neoprene.
B. Isolation devices subject to weather shall have hot-dipped galvanized finish and be furnished with limit stops to resist wind.
C. Coordinate the selection of devices with the isolator and equipment manufacturer.

2.2 MANUFACTURERS
A. Products and methods of fabrication shall be as manufactured by Mason Industries, Korfund Co., Amber/Booth Co., Vibration Mounting & Controls, or Kinetics, similar to the manufacturers model listed.

2.3 TYPE FD FLEXIBLE DUCT CONNECTORS

A. Laminated flexible sheet of cotton duct and sheet elastomer (butyl, neoprene or vinyl), reinforced with steel wire mesh where required for strength to withstand duct pressure indicated. Form connectors with full-faced flanges and accordion bellows to perform as flexible isolation units. Equip each unit with galvanized steel retaining rings for airtight connection with ductwork.

2.4 TYPE D HANGERS

A. Mason type 30N, vibration hangers with steel spring and 0.3" deflection neoprene element in series. Neoprene element shall be molded with a rod isolation bushing that passes through the hanger box. Spring diameters and hanger box shall permit hanger rod to swing 30 deg. arc before contacting the hole and short circuiting the spring.

B. Springs shall have a minimum additional travel to solid equal to 50% of the rated deflection.

2.5 PERFORMANCE

A. Select all vibration isolation devices to provide minimum 95% isolation efficiency or based on the minimum static deflection and mounting criteria listed below, whichever greater.

B. Floor Span

<table>
<thead>
<tr>
<th></th>
<th>On Grade</th>
<th>20 feet</th>
<th>30 feet</th>
</tr>
</thead>
<tbody>
<tr>
<td>Min. Static</td>
<td>Min. Static</td>
<td>Min. Static</td>
<td></td>
</tr>
<tr>
<td>Type Defl.</td>
<td>Type Defl.</td>
<td>Type Defl.</td>
<td></td>
</tr>
</tbody>
</table>

1. Suspended Fans: -- -- FD-D 1.5" FD-D 1.5"

Note: Air Handling Units are internally isolated and do not require external vibration isolation.

PART 3 - EXECUTION

3.1 GENERAL

A. Except as otherwise indicated, apply the following types of vibration isolators at indicated locations or for the following indicated items of equipment. Selection is Installer's option where more than one type is indicated.

B. Spring Isolators:

1. Suspended Fans

C. Flexible Duct Connectors:

1. Duct connections with air handling equipment mounted on vibration isolators.

3.2 INSTALLATION

A. General: Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuit by other contact or bearing points.

B. Anchor and attach units to substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

C. Install vibration isolation devices as specified, as shown on the drawings and according to the manufacturer's installation instructions.
D. In no case shall the installation short circuit the isolation device. Flexible piping connections are to be installed on the equipment side of shut-off valves.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. HVAC work includes:

1. Furnish all labor and materials necessary for the complete installation of heating, ventilating and air conditioning system as shown on the drawings and/or specified herein.
2. Drawings: Refer to H-Series drawings for graphic representations, schedules and notations showing HVAC work.
3. Specifications: Applicable portions of Division 1 govern all work under this Section. Refer to Division 23 Sections for primary technical specifications of HVAC work, as listed below:

- 23 05 00 HVAC General Provisions
- 23 05 90 Testing Adjusting and Balancing
- 23 06 00 Pipe and Pipe Fittings
- 23 06 30 Piping Specialties
- 23 09 10 Supports and Anchors
- 23 10 00 Valves
- 23 14 00 Pumps
- 23 20 00 Vibration Isolation
- 23 25 00 Mechanical Insulation
- 23 62 00 Heating Hot Water Boilers
- 23 63 00 Water Treatment
- 23 74 00 Terminal Air Distribution Units
- 23 74 10 Gas-Fired Heating Units
- 23 77 00 Packaged Rooftop Units
- 23 80 00 Gas-Fired Make-up Air Units
- 23 82 00 Fans
- 23 84 00 Ductwork
- 23 86 00 Ductwork Accessories
- 23 90 00 Controls and Instrumentation
- 23 91 00 Direct Digital Control Systems
- 23 95 00 Control Sequence
- 23 95 10 DDC Point List
- 23 96 00 Starting of Mechanical Systems

4. Equipment structural supports, prime painted.
5. Motors for all HVAC equipment.
6. Secure and pay all construction permit fees.
7. Test, adjust and balance HVAC systems.
8. Commissioning HVAC systems.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. General Work by HVAC Contractor:

1. Field painting of all exposed piping, ductwork, hangers, supports and related metal work, unless noted specifically in the Drawings or Specifications herein.
2. Building provisions for all recesses and chases intended as equipment space for ductwork and piping in new construction.
3. Lintels and openings for ducts and piping through existing walls, floors and ceilings.
4. Line voltage (greater than 100 volts) wiring, conduit and connections.
5. All equipment starters not furnished as integral part of HVAC equipment.

D. Coordination of Work:

1. **General:** Contract Documents are diagrammatic in showing certain physical relationships which must be established within HVAC work, and in its interface with other work including electrical work, and that such establishment is the exclusive responsibility of the Contractor.

2. Arrange HVAC work in a neat, well-organized manner with piping and similar services running parallel with primary lines of building construction, and with minimum of 7 foot overhead clearance where possible.

3. Give right-of-way to piping which must slope for drainage.

4. Advise other trades of openings required in their work for subsequent move-in of large units of HVAC work.

1.3 SHOP DRAWINGS AND SAMPLES

A. The Contractor shall submit to the Architect for approval, shop drawings, giving details, dimensions, capacities, accessories, wiring diagrams, etc., of all materials as indicated in respective specification sections.

B. All shop drawings shall include proper identification of equipment by name and/or number, as indicated in the specification and/or shown on the plans.

C. Shop drawings shall be submitted for approval as soon as practicably possible after award of contract. Shop drawings must be approved before installation of materials and equipment. Drawings shall be submitted in accordance with the requirements outlined in Division 1 of the Specifications.

D. The examination and approval of shop drawings shall not relieve the Contractor from any obligation to perform the work strictly in accordance with the Contract Drawings and Specifications. The responsibility for errors in shop drawings shall remain with the Contractor.

E. Electronic shop drawing submittals require file labeling to match specification section contained and all equipment identified properly compatible with construction documents. All shop drawings improperly labeled and identified will be returned for corrections.

1.4 QUALITY ASSURANCE

A. **Qualifications of Installers:** For the actual fabrication, installation and testing of work under this Section, use only thoroughly trained and experienced workmen completely familiar with the items required and the manufacturer's current recommended methods of installation.

B. In acceptance or rejection of installed work, the Architect will make no allowance for lack of skill on the part of the workmen.

C. **Reference Standards:** Specifically, for HVAC work in addition to standards specified in individual work section, the following standards are imposed, as applicable to work in each instance:

- AABC Associated Air Balance Council
- ADC Air Diffusion Council
- AGA American Gas Association
- AMCA Air Movement and Control Association
- ANSI American National Standard Institute
- ARI Air Conditioning and Refrigeration Institute
- ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers
- ASME American Society of Mechanical Engineers
- ASTM American Society of Testing and Materials
- AWS American Welding Society
- IEEIE Institute of Electrical and Electronics Engineers
- MICA Midwest Insulation Contractors Association
- MSS Manufacturer's Standardization Society
- NBS National Bureau of Standards
- NEBB National Environmental Balancing Bureau
NEC National Electrical Code
NEMA National Electric Manufacturer's Association
NFPA National Fire Protection Association
SMACNA Sheet Metal and Air Conditioning Contractor's National Association
UMC Uniform Mechanical Code
UL Underwriter's Laboratories

All federal, state, local codes, ordinances and utility regulations.

D. Environmental design conditions for all occupied areas are as follows:

<table>
<thead>
<tr>
<th></th>
<th>Winter</th>
<th>Summer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inside</td>
<td>70 degrees F</td>
<td>74 deg. F 50% RH</td>
</tr>
<tr>
<td>Outside</td>
<td>-15 degrees F</td>
<td>91 deg. dbF/75 deg. wbF</td>
</tr>
</tbody>
</table>

E. Approval of Materials: Refer to General Conditions, Supplementary General Conditions and other requirements of Division 1 for approval of materials and requirements of substituted equipment.

1.5 JOB CONDITIONS

A. Building Access: Arrange for the necessary openings in the building to allow for admittance of all HVAC equipment.

B. Temporary Services: No service shall be interrupted or changed without the prior approval of the Owner. Refer to Division 1 requirements.

C. Compatibility: Provide products which are compatible with other products of HVAC work, and with other work requiring interface with HVAC work. Provide products with proper or correct power characteristics, fuel-burning characteristics and similar adaptation for Project. Coordinate selections from among options for compatibility of products. Design and layout is based on equipment scheduled on drawings or in specifications.

1. Contractor shall coordinate installation of equipment supplied by other approved equal manufacturers and shall make necessary field modifications to allow for installation of this equipment at no additional expense to the Owner.

D. Record Drawings: Refer to Division 1 requirements.

PART 2 - PRODUCTS

2.1 ELECTRICAL PROVISIONS OF HVAC WORK

A. General: The electrical provisions of HVAC work, where indicated to be furnished integrally with HVAC equipment, can be summarized, but not by way of limitation, to include the following: 1) Motors, 2) Motor starters, 3) Control switch, pilot lights, interlocks, and similar devices, and 4) Drip pans to protect electrical work.

1. Temperature Control Sub-contractor (T.C.C.) shall furnish and install control wiring as part of the HVAC controls work.
2. Power wiring, connections to equipment, motor control wiring and related work by Electrical Contractor.
3. Motor starters, disconnects, relays, pushbuttons, pilot lights and related motor control items not furnished integrally with HVAC equipment shall be furnished by Electrical Contractor.
4. Provide equipment list, locations and wiring diagrams to Electrical Contractor for all HVAC equipment requiring electrical connections.

B. Motors:

1. Standards: Where not otherwise indicated, comply with applicable provisions of the NEC, NEMA Standards, and sections of Division 16 of specifications. All motors 1 HP and larger shall be NEMA Premium Efficiency motors meeting or exceeding values tested in accordance with IEEE Standard 112, Method B procedures as stated in NEMA MG 1-12.53a and shall be EPACT approved.
2. Temperature Rating: Class B insulation for 70 degree C temperature rise, except where otherwise indicated or required for service.

3. Phases and Current: 1/6 HP and smaller is Contractor's option; up to 1/2 HP, capacitor-start, 120 or 277 volt, 60 cycle single-phase; 1/2 HP and larger, squirrel-cage induction NEMA rated 208 or 487 volt, three-phase, 60 cycle.

4. Service Factor: 1.15 for motors in drip-proof enclosures, all other enclosures to have minimum 1.0 service factor.

5. Construction: Select motors for conditions in which they will be required to perform: i.e., general purposes, splash proof, explosion proof, standard duty, high torque or other special type as required by manufacturer's recommendations. Enclosures shall be of the type recommended by manufacturer for the specified application.


7. Bearings: Permanently lubricated and sealed ball bearings, 1/8 HP and less may be shaded pole type permanently oiled unit bearings.

8. Overload Protection: Built-in thermal; with internal sensing device for stopping motor, and for signaling where required.

C. Starters, Switches: All starters shall have thermal overload and low voltage protection, and shall comply with Electrical Division 16 sections of specifications.

D. Wiring Connections:

1. Motors: Wired connections in flexible conduit, except where plug-in electrical cords are indicated and permitted by governing regulations.

2. General Wiring: Comply with applicable provisions of Electrical Division 16 sections of specifications.

E. Drip Pans: Furnish drain pans below piping which passes directly above electrical work. Locate pan immediately below piping and extend a minimum of 6 inches on each side of piping and lengthwise 18 inches beyond equipment. Fabricate of galvanized sheet metal or copper with 2 inch deep watertight pan, copper drain piping and drain valve

2.2 FLOOR, WALL, ROOF AND CEILING OPENINGS

A. Provide sleeves for pipes and ducts passing through masonry, concrete or other similar construction. Openings for pipes shall be 1" larger in diameter than pipe passing through, including insulation, where indicated. Openings for ductwork shall be 1/2" larger on all sides than size of duct passing through, including duct insulation, where indicated. Coordinate additional space requirements for fire or smoke damper installation.


2. Duct sleeves: 24 gauge galvanized sheet metal, unless noted otherwise.

B. Grout openings between sleeves and concrete or masonry walls and floors with sand-cement mortar consisting of one part portland cement and three parts sand, by volume. Add sufficient water to make a stiff placeable mortar.

C. Close joints between sleeves and non-masonry walls and floors with suitable caulking applied over polyethylene foam backer, compatible with caulking used.

D. Pack annular space between sleeves and insulation pipe or ducts with glass fiber blanket insulation and seal with Urethane caulking compound.

E. Where penetrations occur through fire rated walls or floors, fill annular space with fire-resistive materials in compliance with a UL approved fire rated assembly. Seal annular space through fire rated walls or floors with a UL listed fire resistant sealant and materials in conjunction with the fire rated assembly.

2.3 CUTTING AND PATCHING

A. General: Perform all cutting and patching required for complete installation of HVAC systems, unless specifically noted otherwise. Provide all materials required for patching unless otherwise noted. All cutting and patching necessary of structural members to install any HVAC work shall not be done without permission, and then only carefully done under the direction of the Architect.

B. All new work cut or damaged shall be patched and restored to its original condition.
2.4 EQUIPMENT ACCESS

A. General: All valves, volume dampers, equipment and accessories shall be installed to permit access to equipment for maintenance, servicing or repairs. Any relocation of piping ductwork, equipment or accessories required to provide maintenance access shall be accomplished by the HVAC Contractor at no additional cost to the Owner.

B. Provide access doors where equipment is located in chases or generally inaccessible. Access doors used in fire-rated construction must have UL label. Minimum access panel size 12" x 12" or of sufficient size to allow total access for maintenance. Coordinate location with General Contractor.

C. Access panels shall be furnished and installed by the HVAC Contractor in plaster walls, ceilings and related inaccessible surfaces.

D. Access Doors: Milcor or approved equal, steel frames and door, prime coated, except stainless steel in areas subject to excessive moistures, such as toilet rooms.

2.5 EQUIPMENT SUPPORTS

A. General: Provide all supporting steel and related materials not indicated on structural drawings as required for the installation of equipment and materials, including angles, channels, beams and hangers.

2.6 EQUIPMENT GUARDS

A. General: Provide equipment guards over belt-driven assemblies, pump shafts, exposed fans and elsewhere, as indicated in this specification or required by code.

2.7 CONCRETE FOR HVAC WORK

A. General: All concrete work necessary for HVAC equipment by the HVAC Contractor.

B. General Standards: Except as otherwise indicated, comply with applicable provisions of Division 3 for concrete work.

C. Concrete Equipment Pads: For each piece of HVAC equipment as indicated on the drawings, arrange to install a 4" concrete housekeeping pad a minimum of 2 inches wider than full size of the respective equipment's base. Equipment pads are required for the following equipment.

1. Expansion tank.

2.8 PAINTING HVAC WORK

A. General: All painting of mechanical equipment will be done by the HVAC Contractor unless equipment is hereinafter specified to be furnished with factory applied finish coats. Coordinate the exterior finish painting and color of exterior HVAC equipment with the General Contractor.

1. Exposed ductwork in finished areas outside mechanical rooms shall be cleaned for accepting a paint finish or have factory-applied paint grip finish.

B. Prime paint all field fabricated metal work under HVAC work, comply with applicable provisions of Division 9.

C. All equipment shall be provided with factory applied prime finish, unless otherwise specified.

D. Interior duct surfaces, dampers and other accessories visible through grilles, registers and diffusers shall be painted with flat black paint.

E. If factory finish on any equipment is damaged in shipment or during construction of the building, the equipment shall be refinished by the Contractor to the satisfaction of the Architect.
2.9 HVAC SYSTEM IDENTIFICATION

A. **General:** Provide adequate marking of HVAC system and control equipment to allow identification and coordination of maintenance activities and maintenance manuals. Tag and label HVAC equipment located in exposed or in accessible areas to conform to ANSI A13.1-1981. After painting and/or covering is complete, identify all equipment, piping and ductwork by its abbreviated generic name as shown/scheduled/specified.

B. **Equipment:** Identify all major HVAC equipment with plastic-laminate signs or 2" minimum high painted stencils and contrasting background. Provide text of sufficient clarity and lettering to convey adequate information at each location and mount permanently. Identify control equipment by 1-1/2" x 4" plastic nameplates with 1/2" high lettering.

C. **Piping and Ductwork:** Identify piping and ductwork once every 30 feet at each branch, at termination of lines, and near valve or equipment connections. Place flow directional arrows at each pipe or duct identification. Provide 2" minimum high letters on wrap-around siphonage, adhesive-backed or paint stenciled.

1. Within boiler room provide piping identification every 10 feet and at each branch and termination.

D. **Valves:** Identify all valves with 1-1/2" minimum polished brass stamp-engraved or plastic laminate tags. Prefix or color-code tags for each generic piping service. Prepare and submit valve tag schedule, listing location, service, and tag description, incorporate in Instruction Manual. Mount valve tag schedule behind glass in mechanical room at location determined by Owner.

E. **Operational Tags:** Where needed for proper or adequate information on operation and maintenance of HVAC systems, provide tags of plasticized or laminated card stock, typewritten to convey the message.

PART 3 - EXECUTION

3.1 HVAC WORK CLOSEOUT

A. **Lubrication:** Upon completion of the work and before turning over to the Owner clean and lubricate all bearings except sealed and permanently lubricated bearings. Use only lubricant recommended by the manufacturer.

B. Contractor is responsible for maintaining lubrication of all mechanical equipment under his contract until work is accepted by the Owner.

C. **Cleaning:** After installation has been completed, Contractor shall clean all systems. All piping and ductwork shall be cleaned both internally and externally to remove all dirt, plaster dust or other foreign materials. All temporary throwaway or replaceable media air filters used during the construction period shall be replaced by new filters or new filter media after construction has been completed and before the building is turned over to the Owner. Check all strainers for clean screens.

D. All dirt, plaster dust and other foreign matter shall be blown and/or vacuum cleaned from coils, terminal devices, diffusers, registers and grilles. Equipment shall be thoroughly cleaned of all stains, paint spots, dirt and dust.

E. **Housecleaning and Cleanup:** Periodically as work progresses and/or as directed by the Architect, the Contractor shall remove waste materials from the building and leave his area of work broom clean. Upon completion of work, remove all tools, scaffolding, broken and waste materials, etc., from the site.

3.2 INSTRUCTION AND MAINTENANCE MANUALS

A. **Instruction Manuals:** Upon completion of work, but before final acceptance of the system, furnish to the Engineer for approval, three (3) instruction and maintenance manuals in loose leaf binders. One approved copy shall be returned for use during instructional period. Manual shall have an index of contents and tab for each piece of equipment or system, as well as the following:

1. Manufacturer's O&M instructions, parts list and data sheets.
2. Copies of all shop drawings.
3. Wiring diagrams.
4. Start-up and shutdown procedures.
5. Composite electrical diagrams, and flow diagrams.
6. Test records.

C. **Equipment Parts Lists:** Include a complete list of all equipment furnished for project, with a tabulation of descriptive data of all the equipment replacement parts proposed for each type of equipment or system. Properly identify each part of part number and manufacturer.

D. Instruct Owner's maintenance personnel in the operation and maintenance of all equipment, including composite operating cycle of all equipment. Include not less than 8 hours of instruction, using the O&M manuals during this instruction. Demonstrate startup and shutdown procedures for all equipment.

E. **Service Organizations:** At time of substantial completion, Contractor shall provide Owner with listing of qualified service organizations, including addresses and telephone numbers for each piece of major equipment.

### 3.3 RECORD DRAWINGS

A. Refer to Division 1 for further requirements.

B. Maintain a record set of as-built drawings for all HVAC work performed. As-built drawings shall be continuously updated as the project progresses and be available or periodic inspection by the A/E.

### 3.4 GUARANTEE PERIOD

A. Guarantee all equipment, materials, and workmanship to be free from defects for one year after acceptance by the Owner. Repair, replace or alter systems found defective at no extra cost to the Owner.

B. At the time of substantial completion, turn over the prime responsibility for operation of HVAC equipment and systems to the Owner's operating personnel. During guarantee period, provide one operating engineer, familiar with the work, to consult with and continue training Owner's personnel on an as-need basis.

**END OF SECTION**
SECTION 23 0590
TESTING, ADJUSTING AND BALANCING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. General Requirements: Contractor shall be responsible for providing complete test-adjust-balance (TAB) work of all hydronic and air systems including distribution systems and the equipment and apparatus connected.

B. Work Included:

1. The extent of TAB work is indicated by the requirements of this section, and also by drawings and schedules, and is defined to include, but is not necessarily limited to, hydronic and air distribution systems, and associated equipment and apparatus of HVAC work.

2. The work consists of setting speed and volume (flow) adjusting facilities provided for the systems, recording data, conducting tests, preparing and submitting reports, and recommending modifications to the work as required by the Contract Documents.

3. The component types of testing, adjusting and balancing specified in this section include but are not limited to the following HVAC equipment:
   a. Air handling units and fan units.
   b. Hydronic distribution.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

1. 23 06 00 Piping Specialties
2. 23 14 00 Pumps
3. 23 74 00 Terminal Air Distribution Units.
4. 23 77 00 Packaged Rooftop Units.
5. 23 80 00 Gas-fired Make-up Air Units
6. 23 82 00 Fans.
7. 23 90 00 Controls and Instrumentation
8. 23 96 00 Starting of Mechanical Systems

1.3 QUALITY ASSURANCE

A. Tester: Performed by an Independent Trade who is specifically and actively engaged in the balancing business and regularly does such work. Certified by the NEBB (National Environmental Balancing Bureau), AABC (Associated Air Balance Council) or approved equal in those testing and balanced disciplines similar to those required for this project.

B. Reference Standards: Comply with AABC's Pub. No. 12173, "National Standards for Field Measurements and Instrumentation, Total System Balance", as applicable to HVAC air and hydronic distribution system and associated equipment and apparatus.

C. Industry Standards: Comply with ASHRAE recommendations pertaining to measurements, instruments and testing, adjusting and balancing, except as otherwise indicated.

D. Submittals:

1. Submit six (6) certified test report and types of instruments used and their most recent calibration data with submission of final test report.

2. Final test report shall bear the name of the person who recorded the data and the seal of the supervisor of the balancing trade.
E. Guarantee: Guarantee that all TAB work be performed in accordance with NEBB or AABC standards and that all air systems operate within plus or minus 10 percent of the design flow rates as shown on the plans and/or as scheduled.

1.4 JOB CONDITIONS

A. Do not proceed with testing, adjusting and balancing work until the work to be TAB’ed has been completed and is operable. Ensure that there is no latent residual work still to be completed.

1. Do not proceed until the work scheduled for TAB’ing is clean and free from debris, dirt and discarded building materials.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Patching Materials:

1. Except as otherwise indicated, use same products as used by original Installer for patching holes in insulation, ductwork and housing which have been cut or drilled for test purposes, including access for test instruments, attaching jigs, and similar purposes.

2. At Tester’s option, plastic plugs with retainers may be used to patch drilled holes in ductwork and housing.

B. Test Instruments: Utilize test instruments and equipment for the TAB work required, of the type, precision and capacity as recommended for the following TAB standards: AABC’s National Standards for Field Measurements and Instrumentation, Total Balance System.

PART 3 - EXECUTION

3.1 ADJUSTMENT AND TESTING

A. Tester must examine the installed work and conditions under which testing is to be done to ensure that work has been completed, cleaned and is operable. Notify the Contractor in writing of conditions detrimental to the proper completion of the test-adjust-balance work. Do not proceed with the TAB work until unsatisfactory conditions have been corrected in a manner acceptable to the Tester.

B. Test, adjust and balance the environmental systems and components, as indicated, in accordance with the procedures outlined in the applicable standards.

C. Prepare report of the test results including instrumentation calibration reports in format recommended by the applicable standards.

D. Patch holes in insulation, ductwork and housings, which have been cut or drilled for test purposes, in a manner recommended by the original Installer.

E. 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.

3.2 AIR SYSTEMS

A. Test, adjust and balance systems in accordance with the following procedure:

1. Preliminary:
   a. Identify and list size, type and manufacturer of all equipment to be tested, including air terminals; check all system components for proper installation and operation.
   b. Use manufacturer’s ratings for all equipment to make required calculations except where field test shows ratings to be impractical.
   c. Verify that all instruments are accurately calibrated and maintained.
   d. Install clean filters furnished by the mechanical contractor in all equipment.
2. **Central System:**
   a. Test, adjust and record supply fan RPM design requirements within limits of mechanical equipment provided.
   b. Test and record motor voltage and running amperes including motor nameplate data and starter heater ratings.
   c. Make Pitot tube traverse of main supply, return and fresh air return ducts, determine and record CFM at fan and adjust fan to design CFM.
   d. Test and record total system static pressure and suction and discharge static pressure across coils, filters and related air handling sections.
   e. Test and adjust systems for design recirculated air; CFM.
   f. Test and record cooling apparatus entering air temperatures; dry bulb and wet bulb.
   g. Test and record heating apparatus entering and leaving air temperatures; dry bulb.

3. **Each Fan:**
   a. Each outlet and inlet average velocity, area, CFM.
   b. Test and record total system static pressure at suction and discharge of fan coils.
   c. Fan RPM motor RPM.
   d. Motor name plate current testing.
   e. Motor current draw.

4. **Distribution:** Adjust zones or branch ducts to proper design CFM, supply; return and exhaust.

5. **Air Terminals:**
   a. Identify each air terminal from reports as to location and determine required flow reading.
   b. Test, adjust and balance each air terminal to within 10% of design requirement. Record readings.
   c. Set minimum and maximum flow rates for VAV terminals at specified supply duct pressures and 90% system diversity(10% terminal units at minimum flow rate).

6. **Verification:**
   a. Prepare summation of reading of observed CFM for each system, compare with required CFM and verify that values are within 10% of specified quantities. Determine final coil and filter static pressure drops.
   b. Verify design CFM at fans as described above.

### 3.3 HYDRONIC SYSTEMS

A. Test, adjust and balance system in accordance with following procedures:

1. **Preliminary:**
   a. List all mechanical specifications of tested equipment verify against contract documents. Check all system components for proper installation and operations. Clean all screens.
   b. Open all line valves to full open position. Close coil bypass stop valves, then set mixing control valve to full coil flow.
   c. For each pump, verify rotation, test and record pump shut-off head and test and record pump wide-open head.
   d. Verify proper water level in expansion tanks and in the system.
   e. Verify that air vents in high points of water systems are installed and operating freely.
   f. Verify that all instruments are accurately calibrated and maintained.

2. **Central Equipment:**
   a. Set and record hot water pumps to proper flow quantity.
   b. Adjust and record flow of hot and chilled water through boilers and chiller equipment to design quantities.
   c. Observe and record leaving water temperature and return water temperatures at boiler, chiller equipment and zone water distribution loops. Reset to correct design temperatures.
   d. Record pump operating suction and discharge pressures. Determine final dynamic head.

3. **Distribution:**
   a. Balance and record flow to each hot and chilled water hydronic zone and terminal unit. For heating mode and cooling mode (chiller).
   b. Adjust and record terminal unit flow rates and pressure drops.
   c. Adjust and record coil flow rates and pressure drops. Verify entering and leaving water temperatures at coil terminals.
3.4 AUTOMATIC CONTROL SYSTEM

A. Temperature control manufacturer's representative sets and adjusts automatically operated devices to achieve required sequence of operations.

B. Testing organization verifies all controls for proper calibration and list those controls requiring adjustment by temperature control system installer.

END OF SECTION
SECTION 23 0600
PIPE AND PIPE FITTINGS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of pipe and pipe fitting work is indicated on drawings and by the requirements of this section.

B. Types of pipe and pipe fittings required for this project include the following:
   1. Heating hot water.
   2. Make-up water.
   3. Condensate and drainage.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:
   1. 23 05 00 HVAC General Provisions
   2. 23 06 30 Piping Specialties
   3. 23 09 10 Supports and Anchors
   4. 23 10 00 Valves
   5. 23 63 00 Water Treatment

1.3 QUALITY ASSURANCE

A. American National Standards Institute, ANSI:

B. Welder Qualifications:
   1. Prior to starting any metallic welding, Contractor shall submit his Standard Welding Procedure Specification
      together with the Procedure Qualification Record as required by Section IX of the ASME Boiler and Pressure
      Vessel Code and/or the National Certified Pipe Welding Bureau.

C. Employ piping materials meeting the latest revision of ASTM specifications as listed in this specification.

1.4 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Where possible, store pipe and tube inside and protected from weather. When necessary to store outside, elevate well
   above grade and enclose with durable, waterproof wrapping.

B. Prevent dirt and construction debris from accumulating inside the pipe and pipe fittings, cap open ends whenever possible.
   Store plastic pipe out of direct exposure to sunlight and support to prevent sagging and bending.

1.5 SUBMITTALS

A. Submit schedule of pipe and pipe fittings showing manufacturer and catalog number.

B. Submittal may be in the form of a typewritten list, with proper references, indicating service and pipe or pipe fitting
   specifications.
PART 2 - PRODUCTS

2.1 HOT WATER SYSTEM

A. 2" and smaller:
   1. ASTM A-53 Type F, standard weight, schedule 40, black steel pipe with class 125, standard weight cast iron threaded fittings.
   2. ASTM B88 seamless, Type L, hard temper copper tube with wrought copper 95-5 solder-joint fittings.
   3. Mechanical compression type fittings with integral o-ring seal, Viega ProPress or approved equal.
   4. Rated PEXa piping may provided from copper manifolds to terminal unit reheat coils.

2.2 MAKE-UP WATER

A. ASTM B88 seamless, Type L, hard temper copper tube with wrought copper 95-5 solder-joint fittings.

2.3 CONDENSATE AND DRAINAGE

A. 1" or less: Schedule 40 PVC piping; protect from foot traffic and physical damage. Solvent weld drainage pattern fittings.

2.4 DIELECTRIC UNIONS

A. 1" and smaller: ASTM A197/ANSI B16.3 WOG malleable insulating unions with vulcanized fiber insulating sleeve and neoprene gasket, equal to Stockam Figure 693-1/2, or EPCO model FX or FB dielectric unions with Epconite No. 2 gasket, 250 PSIG at 210 degrees F.

B. 1-1/2" and larger: EPCO model GX dielectric flange with Epconite No. 2 gasket, 175 PSIG at 210 degrees F.

C. Clear flow dielectric fittings may be used in lieu of dielectric unions for pipe sizes 2" and smaller.

2.5 UNIONS AND FLANGES

A. 2" and smaller:
   1. ASTM A197/ANSI B16.3 malleable iron unions with brass seats. Use black malleable iron on black steel piping and galvanized malleable iron on galvanized steel piping. Copper unions with all copper piping. Stainless steel unions with all stainless steel pipings.
   2. Use unions of a pressure class equal to or higher than specified for the fittings of the respective piping service.

PART 3 - EXECUTION

3.1 PREPARATION

A. Set pipe on end and hammer sides to remove foreign materials before erection. Ream ends of all piping to remove burrs.

3.2 ERECTION

A. Install all piping parallel to building walls and ceilings and at such heights not to obstruct any portion of window, doorway, stairway, or passageway. Where interferences develop in the field, offset or reroute piping as required to clear such interferences. In all cases, consult drawings for exact location of pipe spaces, ceiling heights, door and window openings or other architectural details before installing piping.

B. Provide anchors, expansion joints, swing joints and expansion loops so that piping may expand and contract without damage to itself, equipment or building.

C. Mitered ells, notches tees and "orange peel" reducers are not acceptable. On threaded piping, bushings are not acceptable.

D. "Weld-o-lets" and "Thread-o-lets" may be used for branch takeoff up to one half (1/2) the diameter of the main.
E. Install drains throughout the systems to permit complete drainage of the entire system.

F. Do not install piping through dedicated electrical rooms or spaces unless the piping is serving this room or space.

G. Install 2" deep galvanized sheet metal drain pans below piping which passes over electrical switching apparatus. Pipe drain pans to an accessible location with a drain valve and hose bibb adapter such that the system may be drained without damage to other equipment, insulation or finished spaces.

H. Install all valves, control valves and piping specialties, including items furnished by others, as specified and/or detailed. Make connections to all equipment installed by others where that equipment requires the piping services indicated in this section.

3.3 INSTALLATION OF PIPE

A. Run pipe lines straight and true, parallel to building lines with minimum use of offsets and couplings.

B. Provide only such offsets as may be required to provide necessary head room or clearance and to provide necessary flexibility in pipe lines.

C. Changes:
   1. Changes in direction of pipe lines made only with fittings or pipe bends.
   2. Changes in size shall be made only with fittings.
   3. Do not use miter fittings, face of flush bushings or street elbows.
   4. All fittings of long radius type, unless otherwise indicated.

D. Use full and double lengths wherever possible:
   1. Cut pipe to exact measurement and install without springing or forcing except in case of expansion loops where cold springing is indicated.
   2. Take particular care to avoid creating, even temporarily, undue loads, forces, or strains on valves, equipment or building elements either piping connections or piping supports.

E. Install piping to allow for expansion and contraction without stressing pipe or equipment connected.

F. Provide clearance for installation of insulation and for access to valves, air vents, drains, and unions.

G. Sizing:
   1. Unless otherwise indicated, install all supply piping, including shut-off valves and strainers, to coils, pumps, and other equipment at line size with reduction in size being made only at inlet to control valve or pump.
   2. Install supply piping from outlet of control valve at full size connection in equipment served.
   3. Install outlet piping including dirt pockets or mud legs from equipment full size of connection in equipment served.
   4. Install piping, check valves, strainers, and shut-off valves in these equipment outlet or return lines beyond dirt pockets size of tapping in trap or if no trap, size of equipment connection.

H. Make reductions in water pipes with eccentric reducing fittings installed to provide drainage and venting.

I. Branch Take-Offs:
   1. Liquids: From top, bottom, or side of mains or headers at either 45 degrees or 90 degrees from horizontal plane.
   2. Use main sized saddle type branch connections or directly connecting branch lines to mains in steel piping if main is at least 1 pipe size larger than branch for up to 6 inch mains.
   3. Do not project branch pipes inside main pipe.
   4. Provide flanges or unions at all final connections to equipment, traps and valves to facilitate dismantling.
   5. Arrange piping and piping connections so that equipment being served may be serviced or totally removed without disturbing piping beyond final connections and associated shut-off valves.

J. Pipe Drainage Provision:
1. Slope water piping 1 inch in 40 feet and arrange to drain at low points.

2. Closed Systems:
   a. Equip low points with 3/4 inch valves and hose nipples.
   b. At high points, provide collecting chambers and high capacity float-operated automatic air vents or manual air vents.

3.4 THREADED PIPE JOINTS

A. Cut threads so that no more than three threads remain exposed after the joint is made. Ream all pipe ends after cutting and clean before erection. Use a thread lubricant when making joints; no hard setting pipe thread cement or caulking will be allowed.

3.5 COPPER PIPE JOINTS

A. Remove all slivers and burrs remaining from the tube cut by reaming and filing both pipe surfaces. Clean fitting and tube with emery or sand cloth. Remove residue from the cleaning operation, apply flux and assemble joint. Use solder or brazing to secure joint as specified for the specific piping service.

3.6 WATER SYSTEMS

A. Pitch horizontal mains up at 1 inch in 40 feet in the direction of flow. Install manual air vents at all high points where air may collect. If vent is not in an accessible location, extend air vent piping to the nearest code acceptable drain location with vent valve located at the drain.

B. Main branches and runouts to terminal equipment may be made at the top, side or bottom of the main provided that there are drain valves suitably located for complete system drainage and manual air vents are located as described above.

C. Use top connection to main for upfeed risers and bottom connection to main for downfeed risers. Connections at a main may be made with a tee and a 45 degree elbow.

D. Use a minimum of two elbows in each pipe line to a piece of terminal equipment to provide flexibility for expansion and contraction of the piping system. Offset pipe connections at equipment to allow for service, such as removal of the terminal device.

E. Use eccentric fittings for changes in horizontal pipe sizes with the fittings installed for proper air venting. Concentric fittings may be used for changes in vertical pipe sizes.

F. When other specification sections or piping details do not require a strainer upstream of each control valve, install bottom connections to a main with a capped dirt leg.

G. Where copper piping is allowed for heating hot water or solar hot water systems, secure all joints and fittings with 95-5 tin-antimony solder or brazing alloys.

H. Where mechanically formed tee fittings are allowed, form mechanically extracted collars in a continuous operation, consisting of drilling a pilot hole and drawing out the tube surface to form a collar having a height of not less than three times the thickness of the tube wall. The collaring device shall be adjustable.

I. Notch and dimple the branch tube. Braze the joint. Apply heat properly so that pipe and tee does not distort. Remove distorted connections.

3.7 VENTS AND RELIEF VENTS

A. Install vent line and relief valve discharge lines as indicated on the drawings, as detailed, and as specified for each specific valve or piping specialty item.

3.8 COOLING COIL CONDENSATE

A. Trap each cooling coil drain pan connection with a trap seal of sufficient depth to prevent conditioned air from moving through the piping. Extend drain piping to nearest code approved drain locations. Construct trap with plugged tees for cleanout purposes as detailed.
3.9 DIELECTRIC UNIONS

A. Install insulating or dielectric unions or flanges at each point where a copper to steel pipe connection is required in the following systems.

1. Cold water or non-potable make-up water lines.
2. Hot water system.
3. Dielectric unions shall not be used at terminal heating/cooling devices.

3.10 UNIONS AND FLANGES

A. Install a union or flange, as required, at each automatic control valve and at each piping specialty or piece of equipment which may require removal for maintenance, repair or replacement. Where a valve is located at a piece of equipment, locate the flange or union connection on the equipment side of the valve.

1. Concealed unions or flanges are not acceptable.

3.11 PIPE SYSTEM LEAK TESTS

A. Conduct pressure test with test medium of air or water unless specifically indicated. If leaks are found, repair the area with new materials and repeat the test; caulking will not be acceptable.

B. No systems to be insulated until it has been successfully tested. If required for the additional pressure load under test, provide temporary restraints at expansion joints or isolate them during the test. Minimum test time shall be as scheduled below plus such additional time as may be necessary to conduct the examination for leakage.

C. For hydrostatic tests, use clean water and remove all air from the piping being tested by means of air vents or loosening of flanges. Measure and record test pressure at the high point in the system.

D. For air tests, gradually increase the pressure to not more than one half of the test pressure; then increase the pressure in steps of approximately one-tenth of the test pressure until the required test pressure is reached. Examine all joints and connections with a soap bubble solution or equivalent method. The piping system exclusive of possible localized instances at pump or valve packing shall show no evidence of leaking.

E.

<table>
<thead>
<tr>
<th>System</th>
<th>Test Pressure</th>
<th>Medium</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat Water</td>
<td>100 PSIG</td>
<td>Water</td>
<td>8 hours</td>
</tr>
</tbody>
</table>

3.12 PIPE CLEANING

A. Flush all water and condensate systems clear of all dirt and foreign matter with all pumps bypassed and all strainers removed from strainer bodies. Provide circulation by means of Trade Supplied portable pumping apparatus.

B. After initial flushing of a system, use portable pumping apparatus for a continuous 24 hour circulation of a cold water detergent equal to Nalco 2567 cleaner. Flush detergent clear with continuous draining and raw water fill for an additional 12 hours or until all cleaner is removed from the system. Replace strainers and reconnect permanent pumping apparatus.

3.13 INITIAL SYSTEM FILL AND VENT

A. Fill and vent all systems with proper working fluids.

B. Fluids to be chemically treated as specified in Water Treatment Section 15639B.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Thermometers, sockets and test wells.
B. Pressure gauges.
C. Pipeline strainers.
D. Manual and automatic air vents.
E. Flow sensors.
F. Air Separators.
G. Buffer Tanks.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.
B. Specified Elsewhere:
   1. 23 05 90  Testing, Adjusting and Balancing
   2. 23 06 00  Pipe and Pipe Fittings

1.3 QUALITY ASSURANCE

A. Standards:

1.4 SUBMITTALS

A. Submit shop drawings for all items including all data concerning dimensions, capacities, materials of construction, ratings, ranges, pressure drop and appropriate identification.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Construct devices for the highest pressures and temperatures existing in the respective systems in accordance with ANSI specifications.

2.2 THERMOMETERS

B. Pipeline mounted: Thermometers shall be mercury reading, 9" scale cast aluminum case industrial thermometers with clear acrylic plastic window front and adjustable angle stem to permit easy reading from the floor or operating platform. Furnish with extended necks suitable for insulated piping as required. Thermometers shall be compatible with sockets as specified herein.
C. Panel or remote mounted: Thermometers shall be mercury vapor actuated dial type with remote bulb. Casing shall be 3-1/2" minimum diameter cast metal with double front. Sensing bulbs shall be of length to suit pipe diameter with extended necks as required for insulated piping, suitable for insertion in separable brass sockets as specified herein.

D. The range of thermometers shall be:

<table>
<thead>
<tr>
<th>Service</th>
<th>Scale Range</th>
<th>Increment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Water</td>
<td>30 deg. F to 240 deg. F</td>
<td>2 deg. F</td>
</tr>
</tbody>
</table>

E. Thermometers by the temperature control manufacturer meeting the above specification will be acceptable.

2.3 THERMOMETER SOCKETS AND TEST WELLS

A. Sockets and test wells shall be brass with threaded connections suitable for thermometer bulbs and control sensing devices. Socket and test wells length shall be suitable for pipe diameter with extended necks as required to suit pipe insulation.

2.4 PRESSURE GAUGES


B. All gauges shall be suitable for the pressure service intended, with minimum 4-1/2" diameter dial cast aluminum case, double strength glass window, phosphor bronze bourdon tube with bronze bushed brass movement, and recalibration from the front of the gauge dial, 99% accuracy over the middle half of the scale.

1. Gauges shall meet ANSI grade A specifications.
2. Gauges by the temperature control manufacturer meeting these specifications will be acceptable.
3. The range of pressure gauges shall be:

<table>
<thead>
<tr>
<th>Scale Range</th>
<th>Decrement</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Water 0 PSIG to 100 PSIG</td>
<td>1 PSIG</td>
</tr>
</tbody>
</table>

C. Pressure snubbers shall be 1/4" size and of all bronze construction, 300 PSIG working pressure. Coil siphons shall be 1/4" size and of bronze construction, 150 PSIG working pressure.

D. Brass needle type gauge valves, Trerice model 735-2 or other approved product.

2.5 PIPELINE STRAINERS


B. Strainers 2" and smaller: Full pipeline size, "Y" type, 250 psi W.P. steam, cast iron, with screwed ends. Furnish stainless steel strainer with a removable plug type screen retainer unless otherwise indicated on the drawings.

C. Liquid service: Screens to be brass or stainless steel with 1/32" diameter perforation for sizes thru 2" and 1/16" diameter perforation for sizes over 2" for closed piping systems and 1/8" diameter perforation for open piping systems. Maximum pressure drop to be 4 feet W.G. in clean strainer.

2.6 AIR VENTS

A. Manual air vents for components and pipe, Bell & Gossett Model 4V or other approved product, 125 PSIG at 210 deg. F. Use 1/2" gate valve for main pipes.

B. Automatic air vents shall be pilot operated. Spirovent model spirotop, Thrush-Amtrol model 720, Watson McDaniel model 830, B&G model 107 or other approved product.

1. Cast iron or bronze body with non-ferrous internal parts, designed to vent air automatically with float control.

C. Vents shall be constructed of metal for maximum operating pressure of 150 psi and maximum operating temperature of 250 deg. F and all working parts shall be noncorrosive.
D. Vents shall have minimum air elimination rate of 36 CFM at 80 PSIG and shall be fully open for the removal of air at all pressures in the operating range from 2 to 150 psi. It shall be tightly sealed against loss of system water and prevent entrance of air in negative pressure situations.

2.7 FLOW SENSORS

A. Calibrated Balancing Valves:

1. **2" and smaller**: Construct valves of all bronze with threaded connections for sizes 2" and below and for 125 PSIG working pressure at a maximum temperature of 250 deg. F. Provide valve with quick disconnect taps with built-in check valve for pressure differential measurement and integral valve setting index.

2. Select valves for size and pressure drop shown on the drawing and/or schedules. Tag valve plan mark number, flow and pressure drop as specified.

3. **Manufacturers**: B&G CB plus calibrated balance valves or approved equal.

2.8 AIR SEPARATORS

A. **Approved Manufacturers**: Spirovent.

1. Micro bubble eliminator.

2. Dirt separator.

B. **1-1/2" and Smaller**: Cast iron construction with steel diffuser tube, bottom and side threaded inlet connections, bottom and top threaded outlet connections, threaded top connection for air elimination, designed for a maximum working pressure of 125 PSIG.

C. **2" and Larger**: Cast iron or welded steel construction, flanged and/or threaded connections, perforated stainless steel air collector tube to direct air toward the air elimination connection at the top of the unit, tangential water inlet and outlet connections, bottom blow down connection, constructed in accordance with ASME boiler and pressure vessel code and stamped for 125 PSIG design pressure.

D. Unless indicated otherwise, provide each unit with a removable galvanized steel system strainer with 3/16" diameter perforations and a free area not less than five times the cross sectional area of the connecting pipe.

2.9 BUFFER TANKS

A. **Tanks shall be constructed per ASTM A-569 steel certification of 12 or 14-gauge welded steel and factory insulated with foam insulation to meet R-14 value with an outer shell of high density polythylene plastic. All tanks shall be factory tested for leaks at 1-1/2 times working pressure of 75 psig.**

B. **Buffer tank shall include four(4) piping connections - two(2) high and two(2) low with a 1/2" brass automatic air vent at the top and 3/4" drain connection at the bottom. Provide threaded thermo well for installation of aquastat immersion sensor.**

C. **Buffer tank shall be warrantied for 3-years from manufacturing material defects and leaks.**

PART 3 - EXECUTION

3.1 PIPELINE STRAINERS

A. Install strainers in steam and water systems on the entering side of all automatic valves and as shown on the drawings and details.

B. Install strainers in water systems on the suction side of all pumps and elsewhere as indicated on the plans and/or as scheduled.

C. Install drain valve with hose adapter in each blow off connection and extend drain piping to nearest floor drain.

3.2 THERMOMETERS
A. Install thermometers in thermometer sockets in locations indicated on the drawings and details.
B. Install sockets at each point where a temperature sensing device is required under Section 15900B - Controls and Instrumentation, and a thermometer location as shown on the piping drawings and details.

3.3 PRESSURE GAUGES
A. Install pressure gauges where indicated on the drawings and details.
B. Install gauges for water service with pressure snubbers and gauge valves.

3.4 PRESSURE GAUGE TAPPING
A. Install tappings at each point where sensing device is required under Section 15900B - Controls and Instrumentation and at gauge locations as shown on the drawings and details.
B. Install tappings for water service with pressure snubbers and gauge valves.

3.5 AIR VENTS
A. Install manual air vents where indicated on the drawings, details and at all high points in water systems where air may collect.
B. Install automatic air vent at the top of the air separator and where shown on drawings with a shut-off valve between air separator and air vent.

3.6 FLOW SENSORS
A. Install flow sensors as indicated on the drawings and/or schedules and in accordance with the manufacturer’s recommendations.

3.7 AIR SEPARATORS
A. Install air separators in the locations as shown on the plans, details and/or schedules.
B. Provide valved blow down connections and extend drain piping to nearest floor drain.

3.8 BUFFER TANKS
A. Install buffer tanks in the locations as shown on the plans, details and/or schedules on concrete pad.
B. Install thermostatic sensor in thermo well as scheduled.
C. Provide valved blow down connections and extend drain piping to nearest floor drain.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Pipe hangers and supports for mechanical system piping.

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 govern work under this section.
B. Specified Elsewhere:
   1. 23 06 30 Piping Specialties
   2. 23 20 00 Vibration Isolation
   3. 23 25 00 Mechanical Insulation

1.3 QUALITY ASSURANCE
A. Standards:
   1. ANSI B31.1: Power Piping
   2. MSS SP58 & SP69

1.4 SUBMITTALS
A. Submit shop drawings for the following:
   1. Schedule of all manufactured hanger and support devices, indicating type of device for each pipe size range and type of service, including shielding devices as specified.

1.5 MANUFACTURERS
A. Grinnell, Fee and Mason, Michigan Hanger, B-Line or Elcen, or approved equal.
B. Grinnell figures listed as reference only.

PART 2 - PRODUCTS

2.1 GENERAL
A. Materials and application of pipe hangers and supports shall be in accordance with MSS Standard Practice SP-58 and SP-69 unless otherwise specified.
B. Design supports of strength and rigidity to suit loading, service, and in manner, which will not unduly stress the building construction. Where support is from concrete construction, take care not to weaken concrete or penetrate waterproofing. Fasten supports and hangers to building steel framing whenever practical. Do not use perforated iron, chain or wire as hangers.
C. Where piping can be conveniently grouped to allow the use of trapeze type supports, the supporting steel shall be by means of standard structural shapes or continuous insert channels. Where continuous insert channels are used, pipe-supporting devices made specifically for use with the channels may be substituted for the specified supporting devices provided that similar types are used and all data is submitted for approval.

2.2 EQUIPMENT SUPPORTS
A. Provide all supporting steel, not indicated on the structural drawings, that is required for the installation of mechanical equipment and materials, including angles, channels, beams, etc. to suspend or floor support tanks and equipment.

B. Refer to HVAC Drawing details for further requirements.

2.3 PIPE HANGERS AND SUPPORTS

A. Manufacturers: Grinnell, Fee and Mason, Michigan Hanger, B-Line or Elcen similar to the Grinnell figures listed.

B. Pipe Hangers Application:

1. 2" and smaller: Adjustable, swivel split ring type Grinnell Fig. 104 or lightweight, adjustable clevis type Grinnell Fig. 65.

2. 2-1/2" and larger: Adjustable clevis type Grinnell Fig 260.

C. Hangers for copper pipe without insulation shall be either copper plated or PVC coated.

D. Hot piping 2" and smaller: Hanger may be secured directly to the pipe with insulation system around hanger.

2.4 INSULATION PROTECTION SHIELDS

A. Application: Insulation protection shields are required on the following piping systems:

1. Cold piping (under 60 deg. F): All sizes.

2. Hot piping (over 120 deg. F): 2-1/2" and larger piping.

B. Insulation Protection Shields: Grinnell Fig. 167, Fee & Mason or Elcen or other approved product, constructed of galvanized carbon steel. Select shield to accommodate outer diameter of insulation. Shield lengths and gauge shall be as follows:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Length</th>
<th>Gauge</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2&quot; thru 2-1/2&quot;</td>
<td>12&quot;</td>
<td>18</td>
</tr>
<tr>
<td>3&quot; thru 6&quot;</td>
<td>18&quot;</td>
<td>16</td>
</tr>
<tr>
<td>8&quot; thru 12&quot;</td>
<td>24&quot;</td>
<td>14</td>
</tr>
</tbody>
</table>

2.5 HANGER SUPPORT INSULATION

A. Application: Piping 2-1/2" diameter and larger in conjunction with insulation protection shields to resist compression of insulation system.

B. Hanger insulation system shall cover bottom half of pipe at the same thickness as pipe insulation system.

2.6 PIPE HANGER RODS

A. Support rods shall conform to the latest MSS standards except as modified herein.

B. Size rods for individual hangers and trapeze support as indicated in the following schedule:

<table>
<thead>
<tr>
<th>Maximum</th>
<th>Pipe size</th>
<th>Rod Diameter</th>
<th>Load (lbs.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 2&quot;</td>
<td>3/8&quot;</td>
<td>610</td>
<td></td>
</tr>
<tr>
<td>2-1/2&quot; and 3&quot;</td>
<td>1/2&quot;</td>
<td>1130</td>
<td></td>
</tr>
<tr>
<td>4&quot; and 5&quot;</td>
<td>5/8&quot;</td>
<td>1810</td>
<td></td>
</tr>
<tr>
<td>6&quot;</td>
<td>3/4&quot;</td>
<td>2710</td>
<td></td>
</tr>
<tr>
<td>8&quot; thru 12&quot;</td>
<td>7/8&quot;</td>
<td>3770</td>
<td></td>
</tr>
</tbody>
</table>

C. Furnish rods complete with adjusting and lock nuts.

D. In piping 4 inches and larger, each valve shall be supported.
2.7 HANGERS AND SUPPORT SPACING

A. Space pipe hangers and supports in accordance with the following schedule, with exceptions as indicated herein:

<table>
<thead>
<tr>
<th>Pipe size</th>
<th>Steel</th>
<th>Copper</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up thru 1-1/4&quot;</td>
<td>8'-0&quot;</td>
<td>6'-0&quot;</td>
</tr>
<tr>
<td>1-1/2&quot; and 2&quot;</td>
<td>10'-0&quot;</td>
<td>8'-0&quot;</td>
</tr>
<tr>
<td>2-1/2&quot; and 3&quot;</td>
<td>12'-0&quot;</td>
<td>10'-0&quot;</td>
</tr>
<tr>
<td>4&quot; and 5&quot;</td>
<td>14'-0&quot;</td>
<td>10'-0&quot;</td>
</tr>
<tr>
<td>6&quot; to 12&quot;</td>
<td>14'-0&quot;</td>
<td>10'-0&quot;</td>
</tr>
</tbody>
</table>

B. Place hangers to meet the requirements of the piping section of this specification, with regard to pitch for drainage and venting, and clearance between services.

C. Place hangers within one foot of each elbow and at each valve and strainer for piping 4" and above.

2.8 BEAM CLAMPS

A. Grinnell Fig. 87 Series beam clamps with retaining clip for hanger rods to 5/8". Maximum load 440 lbs.

B. Grinnell Fig. 228 beam clamps with links for hanger rods 3/4" and above.

2.9 RISER CLAMPS

A. Grinnell Fig. 261 for steel pipe, CT-121 for copper tubing.

2.10 CONCRETE INSERTS

A. Grinnell Fig. 285, 281 or 282, poured concrete ceiling insert, suitable for rod diameter and weight supported.

B. Inserts drilled and placed after concrete pour shall have steel shell with expander plug, not depending on soft lead for holding power.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supports to provide for free expansion of the pipe. Support all piping from the structure using concrete inserts, beam clamps, ceiling plates, wall brackets, or floor stands. Fasten ceiling plates and wall brackets securely to the structure and test to demonstrate the adequacy of the fastening.

B. Coordinate hanger and support installation to properly group piping of all trades.

3.2 INSULATION PROTECTION SHIELDS

A. Install insulation protection shields at support points for insulated piping as scheduled herein.

B. Spacing shall be 10'-0" maximum based on insulation with a compressive strength of 15 psi. For insulation with compressive strengths greater than 15 psi, span may be increased proportionally up to a maximum allowable as listed under hanger and support spacing in this section.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Valves for mechanical system piping.

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 govern work under this section.
B. Specified Elsewhere:
   1. 23 05 90 Testing, Adjusting and Balancing
   2. 23 06 00 Pipe and Pipe Fittings
   3. 23 06 30 Piping Specialties

1.3 SUBMITTALS
A. Submit shop drawings for all valves including all data concerning dimensions, materials of construction and pressure/temperature ratings.
B. Mark shop drawings clearly for each system and note with the correct cross reference number.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Acceptable manufacturers: Powell, Crane, Nibco, Hammond, Stockham, Lunkenheimer, Milwaukee.
   1. Valves shall be of same manufacturer, unless otherwise approved by A/E.
B. Acceptable manufacturer and Fig. No. are listed under each valve type as the standard for equal quality from approved manufacturers.
C. Manufacturer's name and pressure ratings clearly mounted on outside of valve body.
D. All valve packing to be non-asbestos and flexitallic type.

2.2 WATER SYSTEMS VALVES
A. Globe Valves:
   1. Valves 2-1/2" and smaller: Bronze body, screwed pattern, renewable composition disc, union or screw-over bonnet, malleable iron hand wheel, 300 psi W.O.G., Mueller Fig. 203-AP or Metraflex No. 700.
B. Check Valves:
   1. 2-1/2" and smaller: Bronze body, screwed, regrinding type, horizontal swing, renewable seat and disc, 150 SWP - 200 WOG rated. Nibco Fig. T-413-Y.
C. Spring Loaded Check Valves:
   1. Valves 2-1/2" and smaller: Bronze or iron body, bronze trim, stainless steel spring, screwed, 250 psi WOG, Nibco Fig. T-480Y, Mueller Fig. 203-AP or Metraflex No. 700.
D. **Balancing Valves (non-calibrated):**
   1. **Valves 2-1/2” and smaller:** Use eccentric plug valves or ball valves with memory stops.

E. **Balancing Valves (calibrated):**
   1. **Valves 2-1/2” and smaller:** Refer to Section 23 06 30, Piping Specialties, under Flow Sensors and Meters.

F. **Ball Valves:**
   1. **Valves 2-1/2” and smaller:** Bronze body, screwed, brass or stainless steel ball, full or conventional port, Teflon seat rings, blowout-proof stem, two-piece construction, 600 psi WOG, Apollo No. 70 Series, Milwaukee BA 100/150, Nibco T/S 585-70.
   2. Provide valve neck extensions with sufficient length to allow for insulation where insulation is specified.

G. **Drain Valves:**
   1. Bronze, screwed, Buna-N seat discs, hose thread adapter, 125 psi WOG, Nibco Fig 74, or ball valve as specified above with hose thread adapter.
   2. Minimum drain valve size - 3/4” except where strainer blowdown valves are indicated, drain valve same as blowdown connection size.

H. **Combination Shut-off, Check and Balancing Valves:**
   1. 2” and smaller: Provide check valve and balance valve in series at pump discharge.
   3. Design valves to permit repacking under full line pressure.

I. **Shut-off and Check Valves:** Provide spring-loaded check valve and shut-off (ball or butterfly) valve in series at pump discharge.

2.3 **WATER PRESSURE REDUCING VALVES**

A. **Manufacturers:** Thrush, Watts, Cash-Acme, Taco, or B&G valves.

B. Valves shall be diaphragm operated and pressure adjustable with anti-siphon check valve and inlet strainer designed for a maximum working pressure of 125 PSIG at 240 deg F.

C. Set the valves for pressures required, or as scheduled.

2.4 **WATER RELIEF VALVES**

A. **Manufacturers:** Kunkle, Consolidated, Thrush, Watts, Cash-Acme, or B&G. Valves shall be iron or bronze body, diaphragm operated, with non-ferrous seat and designed for a maximum working pressure of 125 PSIG.

B. Relief valves shall conform to State requirements and each valve shall have an ASME stamp.

2.5 **GAUGE VALVES**

A. Trerice Fig. 735, 1/4” brass needle valve, threaded ends, 300 WOG rated.

**PART 3 - EXECUTION**

3.1 **GENERAL**

A. Install valves as shown on plans, details and according to the valve manufacturer's installation recommendations. Install valves with stems upright or horizontal.

B. Install all temperature control valves furnished under Section 15900B - Controls and Instrumentation.
3.2 SHUT-OFF VALVES
A. Install shut-off valves at all equipment, at each branch take-off from mains, and at each automatic valve for servicing.

3.3 THROTTLING VALVES
A. Install globe or angle valves for throttling service and control device or PRV station bypass.
B. Install gate valves for throttling in steam systems sizes 8 inches and larger.

3.4 BALL VALVES
A. Ball valves shall be used for water system shut-off valves.

3.5 BALANCING VALVES
A. Provide balancing valves for complete balancing of water systems. Furnish calibrated balance valves and flow meters as specified in Section 23 06 30, Piping Specialties, under Flow Meters.

3.6 DRAIN VALVES
A. Provide drain valves where specified, detailed and at all low points of piping systems for complete drainage of the systems.

3.7 WATER RELIEF VALVES
A. Install relief valves as shown on drawings.
B. Unless otherwise indicated, provide one relief valve in each closed water system in the pump inlet piping.

3.8 SPRING LOADED CHECK VALVES
A. Provide a spring loaded check valve in each pump discharge line.

3.9 COMBINATION SHUT-OFF, CHECK AND BALANCING VALVES
A. Install combination or triple-duty (shut-off, check and balancing) valve in lieu of providing separate shut-off valve, check valve and balancing valve at water circulation pump discharge line.

3.10 WATER RELIEF VALVES
A. Install water relief valves on closed system hydronic heating systems to relief rated system input capacity. Extend relief outlet to safe location near floor drain.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Types of pumps specified in this section include the following:
   1. Inline Pumps

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 govern work under this section.
B. Specified Elsewhere:
   1. 23 05 90 Testing, Adjusting and Balancing
   2. 23 06 30 Piping Specialties
   3. 23 10 00 Valves
   4. 23 20 00 Vibration Isolation

1.3 QUALITY ASSURANCE
A. UL and NEMA Compliance: Provide electric motors and products which have been listed and labeled by Underwriters Laboratories and comply with NEMA Standards.

1.4 SUBMITTALS
A. Submit certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve, when applicable.
B. Submit all data concerning dimensions, materials of construction, ratings, and other relevant product data.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS
A. Provide factory tested pumps, thoroughly cleaned, and painted with one coat of machinery enamel prior to shipment. Type, size, and capacity of each pump are listed on pump schedule. Provide pumps of same type by same manufacturer.
B. Pump shall meet or exceed the operating efficiencies scheduled.
C. Select motor with sufficient horsepower rating for non-overloading operation over the entire pump curve.
D. All pumps shall operate without objectionable noise or vibration.

2.2 INLINE CENTRIFUGAL PUMPS
A. General: Provide in-line pipe-mounted, single suction, centrifugal type pumps where indicated, and of capacities as scheduled.
B. Acceptable Manufacturers:
   1. Bell and Gossett
   2. Grundfoss
3. Taco.

C. **Casing**: Cast iron bronze - fitted with a working pressure of 175 PSIG and operating temperature of 225 degrees F continuous, 250 degrees F intermittent. Provide tapped and plugged openings for vent, drain, suction and discharge gauge connections.

D. **Shaft**: Alloy steel with integral thrust collar.

E. **Bearings**: Oil lubricated bronze sleeve bearings or regreaseable ball bearings.

F. **Seal**: Mechanical single unbalanced type with Buna-N/Carbon rotating element and ceramic, Ni-resist stationary seat or other approved product.

G. **Impeller**: Single-suction enclosed type, hydraulically and dynamically balanced, and keyed to shaft. Bronze Construction.

H. **Motor**: Non-overloading at any point on pump curve, open, drip-proof, oil-lubricated journal bearings, resilient mounted construction, built-in thermal overload protection on single phase motors.

1. Motor shall be non-overloading over the entire pump curve.

I. **Nameplate**: Each pump and motor shall be provided with a nameplate displaying the manufacturer's name, serial number of pump, capacity in GPM, and head in feet at design, horsepower, voltage, frequency, speed and full load current.

1. Permanently identify exact impeller size of pump on nameplate.

J. **ECM Motor and Controller**: Where scheduled, inline pump shall be equipped with an ECM motor with integral controller for constant pressure control of pump output as setup integrally on motor-mounted controller.

**PART 3 - EXECUTION**

**3.1 INSTALLATION OF PUMPS**

A. Install pumps where indicated, in accordance with manufacturer's published installation instructions, with recommended clearance provided for service and maintenance.

B. Install in-line pumps supported from piping system, located for access to oil cups, service and maintenance. Pipe to be free of all movement.

C. Provide piping, accessories, hangers, supports, and anchors, valves, meters and gauges, vibration isolation, and equipment supports, as indicated for completion installation. All valves and piping specialties are to be full line sizes as indicated on drawings.

1. Install a full line size silent spring loaded check valve and balancing valve in the pump discharge piping.
2. Provide line size ball or butterfly valve and strainer on suction piping.
3. Provide supports under elbows on pump suction sizes 4 inches and over.

D. Lubricate pump before start-up. Start-up in accordance with manufacturer's instructions.

E. Ensure that pump units are wired properly, with rotation in correct direction, and that pump and motor grounding have been provided.

F. **Start-Up Services and Inspection Report**: Manufacturer's representative shall inspect pump installation and start-up pump to verify proper installation, pump shaft alignment and operation, and submit report to Engineer.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of mechanical insulation required by this section is indicated on drawings, and by requirements of this section.

B. Work shall include all labor, equipment, accessories, materials and services required to furnish and install all insulation, fittings and finishes for piping, ducts and related mechanical equipment in the Heating, Ventilating and Air Conditioning Systems.

C. The following types of insulation are specified in this section:

1. Pipe insulation.
2. Duct insulation.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

1. 23 09 10 Support and Anchors
2. 23 84 00 Ductwork

1.3 QUALITY ASSURANCE

A. Acceptable Manufacturers:

1. Owens-Corning
2. Schuller
3. Certainteed

B. All insulating products delivered to the construction site shall be labeled with the manufacturer's name and description of materials.

C. All insulation installation methods shall be performed in accordance with the latest edition of MICA (Midwest Insulation Contractors Association) Standard and manufacturer's installation instructions, except as modified in this section of specifications.

1.4 DEFINITIONS

A. Concealed Ductwork: Concealed areas, where indicated in this section, shall apply to shafts, furred spaces, space above finished ceilings, low tunnels and crawl spaces.

B. Exposed Ductwork: Exposed ductwork, include mechanical rooms, walk-through tunnels, and similar installations subjecting ductwork insulation to physical damage and tearing.

1.5 SUBMITTALS

A. Submit shop drawings for insulation systems, including a schedule for all insulating materials, including adhesives, fastening methods, fitting materials, installed thickness and intended use of each material.

B. Submittal shall include catalog sheets indicating density, thermal characteristics, jacket, and installation instructions.

PART 2 - PRODUCTS
2.1 MATERIALS

A. All products including vapor barriers and adhesives shall conform to NFPA Section 90A. All products except pipe insulation shall possess a flame spread rating of not over 25, without evidence of continued progressive combustion, and a smoke developed rating no higher than 50.

2.2 PIPING INSULATION SCHEDULE

A. Insulation Thickness Pipe Size Schedule:

<table>
<thead>
<tr>
<th>Type of System</th>
<th>Fluid Temp. Range</th>
<th>&quot;Runouts&quot; Up to 2&quot;</th>
<th>1&quot; Less</th>
<th>1-1/4&quot; -2&quot;</th>
<th>2-1/2&quot; -4&quot;</th>
<th>5 &amp; 6 inch Up</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Water:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Low Temp.</td>
<td>141-200</td>
<td>0.5</td>
<td>1.0</td>
<td>1.0</td>
<td>1.5</td>
<td>1.5</td>
</tr>
<tr>
<td>Cooling Systems:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cond. Drains</td>
<td>40-55</td>
<td>0.375</td>
<td>0.375</td>
<td>0.5</td>
<td>0.5</td>
<td>0.5</td>
</tr>
</tbody>
</table>

*Runouts are extensions to individual terminal units not exceeding 12 ft. in length.

B. Insulation thickness shown in schedule are based on products having a maximum "k" factor of 0.26 at a mean temperature of 75 degrees F. These thicknesses can be reduced for products having significantly lower "k" values and shall be increased for products having higher "k" values in order to produce equivalent or greater thermal resistance. (R" value of products equals the thickness of the insulation divided by the "k" factor.)

C. Insulation Application Schedule:

<table>
<thead>
<tr>
<th>Type of System</th>
<th>Fluid Temp. Range (deg. F)</th>
<th>Type of Insulation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hot Water:</td>
<td>141-200</td>
<td>Glass Fiber</td>
</tr>
<tr>
<td>Low Temp/HWS&amp;R</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cooling Systems:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Refrigerant Suction</td>
<td>40-55</td>
<td>Elastomeric</td>
</tr>
<tr>
<td>Cond. Drains</td>
<td>40-55</td>
<td>Elastomeric</td>
</tr>
</tbody>
</table>

2.3 PIPE INSULATION

A. Rigid molded glass fiber pipe insulation with ASJ type factory applied jacketing with a density of 3-4 lbs./cubic feet and a "k" factor of 0.25 @ 75 degrees F. mean. (Flame Spread 25, smoke development 50 per ASTM E 84-75, -20 degrees to 500 degrees F. usage.)

1. Jacket shall be glass fiber reinforced foil kraft laminate, factory applied, with white finish. Permeance shall not exceed 0.02 perms. Beach puncture resistance shall be 50 units minimum.
2. Provide Aluminum or UV-resistant PVC jacket for all exposed exterior piping insulation.

B. Flexible elastomeric thermal insulation with a "k" factor of 0.26 at 75 degrees F mean density of 5.0 lbs./cu. ft. and a maximum water vapor transmission of 0.17 per inch. Seal joints with manufacturers standard sealant. (Armaflex AP-Flame Spread 25, smoke development 50 per ASTM E 84-75, -40 degrees to 220 degrees F usage.)

2.4 DUCTWORK INSULATION

A. Material: Flexible Glass Fiber Wrap: Flexible glass fiber insulation shall have a minimum density of 0.75 PCF with thermal conductivity of not more than 0.31 at 75 degrees F mean temperature and suitable for 240 degrees F with FSK aluminum foil reinforced vapor barrier jacket. Material shall meet NFPA 90A and 90B.
1. Jacket shall be glass fiber reinforced foil kraft laminate factory applied with paintable white finish. Permeance shall not exceed 0.04 perms. Beach puncture resistance shall be 15 units minimum.
2. Provide Aluminum or UV-resistant PVC jacket for all exposed exterior ductwork insulation.

2.5 DUCTWORK INSULATION SCHEDULE

A. Concealed - Supply Air Ducts:
   1. Type Insulation: 2" Flexible Wrap (R8 min).

B. Exposed - Supply Air Ducts:
   1. Type Insulation: 1" Rigid Board (Unconditioned spaces - Mech. Rms.).
      Note: Insulation not required if supply duct is lined. Refer to Section 15840B.
   2. Type Insulation: 2" Rigid Board (Exterior Ductwork - R8 min).
      Note: Insulation thickness may be reduced if supply duct is lined. Refer to Section 15840B.
   3. Exposed ducts in conditioned spaces do not require external insulation.

C. Exhaust and Tempered Exhaust Air Ducts - General Exhaust:
   1. Automatic Control Damper (ACD) to Ambient Outlet (Louver):
      1-1/2" Flexible Wrap (Concealed).
   2. Exhaust Registers to Fan Inlet: None.

D. Fresh and Tempered Fresh Air Ducts:
   1. Fresh Air: 1" Rigid Board (exposed) or 1-1/2" Flexible Wrap (concealed).

E. Transfer Air Ducts:
   1. Type Insulation: 1" Acoustic Duct Liner. Refer to Section 15840B.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Application of insulation materials to piping, equipment, tanks and ductwork shall be done in accordance with manufacturer's written recommendations. Where thickness of insulation is not specified, use applicable thickness recommended by manufacturer and required by applicable codes.

B. All insulation shall be continuous through wall and ceiling openings and sleeves. All covered pipe and ductwork is to be located a sufficient distance from walls, other pipe, ductwork and other obstacles to permit the application of the full thickness of insulation specified. (If necessary, extra fittings and pipe are to be used.).

3.2 PIPING INSTALLATION

A. All pipe installation shall be installed with joints butted firmly together. All valves and fittings shall be insulated with mitered sections of insulation equal in density and thickness to the adjoining insulation by one of the following methods:
   1. Premolded PVC fittings installed in accordance with the manufacturer's instructions.
   2. Jackets on pipe insulation laps are to be vapor sealed using self-sealing lap, lap-seal tape gun or adhesive such as Armstrong 520. All insulation ends are to be tapered and sealed regardless of service.

B. Provide removable insulation sections to permit easy access where inspection, service and/or repairs are required.
1. Insulation for valves, unions (cold only), strainers, flexible connections and expansion joints shall be removable for inspection and repair.

C. On all cold piping insulated with vapor barrier covering, use protection shield to over bottom one-half of insulated pipe. Provide half-round, 12" long, hanger block at the bottom half of the pipe in place of the fiberglass pipe insulation. The hanger blocks shall be molded cork or calcium silicate pipe insulation of the same thickness as the adjoining fiberglass pipe insulation. The vapor barrier jacket shall be continuous through the hanger location.

1. Provide removable elastomeric insulation wraps over cold piping unions.

D. Vapor barrier jackets shall be applied with a continuous, unbroken vapor seal. Pipe hangers on cold lines (dual temperature piping) are to be sized large enough to be installed over the outer surface of the insulation.

E. On hot piping 2" and smaller, the hanger shall be secured directly to the pipe and the pipe insulation shall surround the hanger. Provide pipe covering protection saddles and hanger blocks at hanger locations on hot piping 4" and larger.

F. Insulation shall preferably be applied while surfaces are hot. Chilled water lines shall be at room temperatures when insulation is applied.

G. Omit insulation for the following:
   1. Discharges piping from safety and relief valves to outlets.
   2. Piping unions on hot only (HWS&R) systems.
   3. Provide removable insulation jackets over unions and valves for hot/chilled water systems.
   4. Hot water piping inside convector, wall fin radiation and cabinet heater enclosures.

H. Seal all exposed end sections of pipe covering with a coat of vapor barrier mastic. Childers CP-30 or equal.

I. No covering shall be applied until after piping is cleaned and tested, inspected and approved.

3.3 DUCTWORK INSULATION INSTALLATION

A. Insulation shall be installed per manufacturer recommendations with mechanical fasteners. Seal all joints and fasteners with UL labeled vapor proof tape.

B. Provide finished edges at all access doors and ends.

3.4 INSTALLATION OF EQUIPMENT INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions and in accordance with recognized industry practices to ensure that insulation serves its intended purpose.

B. Install insulation materials with smooth and even surfaces.

C. Clean and dry ductwork surfaces prior to insulating, Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Do not insulate over equipment nameplates or ASME stamps. Bevel and seal insulation at these locations.

E. Do not insulate factory insulated equipment.

3.5 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction; period, to avoid damage and deterioration.

END OF SECTION
SECTION 23 6200
HEATING HOT WATER BOILERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Extent of heating hot water boiler work required by this section is indicated on drawings and schedules, and by requirements of this section.
B. Types of heating hot water boiler specified in this section include the following:
   1. Modular hot water condensing boilers.

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 shall govern work under this section.

1.3 QUALITY ASSURANCE
A. Installers: Contractors certified Contractors for installation of boilers, of types and capacities required, with similar installations in satisfactory use in similar service for not less than 3 years.
B. Regulatory Requirements:
   1. AGA Compliance: Provide heating hot water boilers that have been tested and rated in accordance with American Gas Association.
   3. ASME Compliance: Construct hot water boilers in accordance with American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section IV.
   4. UL Labels: Provide heating hot water boiler ancillary electrical components which have been listed and labeled by Underwriters Laboratories (UL).
D. Warranty:
   1. Sealed combustion boiler, condensing, hi-efficiency, (modular,) helical heat exchanger/combustion chamber design that will be self-supporting, and warranted for a period of 10 years to withstand thermal shock. Heat exchanger shall be warranted against leakage for a period of 10 years.
   2. Heat exchanger/combustion chamber assembly: 3 years.
E. Start-Up Services: Contractor shall provide factory authorized supervision of all phases of equipment start-up.
   1. Manufacturer-approved start-up technician shall commission startup of boilers and boiler plant controller.
   2. Startup Technician shall document operational parameters and submit report itemizing measured parameters and approving the boiler installation.
   3. Provide a startup report and Manufacturer’s letter of compliance with all factory recommendations and installation instructions.

1.4 SUBMITTALS
A. Shop drawings of product data and manufacturer's installation and maintenance manual.

PART 2 - PRODUCTS

2.1 HOT WATER BOILERS
A. General: Provide as indicated, modular units of capacity as scheduled. Provide net ratings approved by AGA, and construct in accordance with requirements of ASME Boiler and Pressure Vessel Code. Boilers shall be gas-fired sealed combustion complete with all accessories.

1. Provide units with capacity and operating characteristics indicated on schedules
2. AGA Design certified input = 11-110,000 BTU/HR.
3. Heating capacity = 10.5-104,500 BTU/HR.
4. Conversion efficiency AFUE = 95%.
5. 10:1 turn down.

B. Approved Manufactures: Lochinvar, IBC, HTP and Laars.

C. Boiler ASME stamped for 160 psig and designed per ASME section IV. Furnish a relief valve in compliance with ASME section IV, and set at 30 psig. All internal combustion chamber, and internal burner components, shall be manufactured with materials suitable to withstand constant operation under condensing conditions. Combustion chamber shall have a condensate drain to discharge any condensate buildup.

D. Boiler efficiency 95%+ per ANSI Z21.13a, and operation in the condensing mode with inlet temperatures as low as 90 F.

E. Combustion air intake capable of accepting either free mechanical room air, or direct outside air through a sealed intake pipe of the length and diameter shown on drawings. Provide inlet/outlet combustion vent temperature fittings with direct outside air application

F. Category IV flue vent connection, condensing positive pressure, for both roof and sidewall venting. The vent outlet shall be compatible with PVC/CPVC plastic vent material.

G. Baked enamel finish boiler sheet metal jacket with removal panels for maintenance access.

H. Inlet and outlet temperature gauge to monitor inlet and outlet water temperatures.

I. Provide a water temperature controller with integral outdoor reset with customizable reset curves, outdoor air sensor and hot water supply header sensor. Controller shall employ electronic PID modulating control to maintain setpoint hot water header temperature. Provide auxiliary contacts for external 4-20ma or 0-10VDC BAS signal to reset of hot water supply, if selected. BACnet protocol controller with network link.

J. Provide each boiler shall be provided with a hydronic flow switch to prevent operation without proper flow.

K. Provide each boiler with dual over temperature protection, including manual reset, in accordance with ASME Section IV and CSD-1.

L. Boiler control panel shall be equipped with a LCD display and keypad to setup control parameter and provide diagnostic interface with operator.

M. Provide remote fault alarm contact for flame sensor and high temperature limit failure.

N. Provide integral primary boiler pump compatible with required boiler flow requirements and powered from boiler relay contacts. The primary pump shall be capable of serving the boiler’s heat exchanger flow requirements with 10 feet equivalent external piping losses.

O. Provide single point 115 volt 1-phase wiring for controls and combustion fan.

P. Natural gas-fired burners, forced draft power type with a positive pressure at the boiler discharge. Stainless steel burner mixer. Maximum Nox emissions under 20 PPM.

1. Gas burner shall modulate down to 10% capacity(10:1 turndown).

Q. Furnish units with fuel trains and operating controls conforming to the latest UL or equivalent agency approval, and shall be factory assembled, wired, mounted, and factory fire tested.
PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which boilers are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF BOILERS

A. **General**: Comply with boiler manufacturer's instructions for installation, except as otherwise indicated.

B. Comply with installation requirements of local and state boiler codes, and applicable provisions of NFPA and ASME boiler code standards.

C. Install boilers on 4” high concrete pad where indicated, maintain manufacturer's recommended clearances around and over top of boilers.

D. Install boiler trim not installed at factory.

E. Connect water, fuel, piping, and venting as indicated.

F. Furnish to Electrical installer, manufacturer's wiring diagram and electrical requirements for installation of field-wiring required for heating hot water boilers, not work of this section.

G. Flush and clean heating hot water boiler upon completion of installation, in accordance with manufacturer's start-up instructions.

H. Start-up heating hot water boilers, in accordance with manufacturer's start-up instructions, and in presence of boiler manufacturer's representative. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning control and equipment.

I. Hydrostatically test assembled boiler and piping in accordance with applicable sections of ASME Boiler and Pressure Vessel Code.

J. Arrange with National Board of Boiler and Pressure Vessel Inspectors of inspection of boiler piping, observation of hydrostatic testing, and for certification for completed boiler unit.

K. Install a drain valve at low point to boiler assembly.

L. Each boiler is to have a butterfly valve for isolation and maintenance, along with a calibrated balance valve for flow balancing between boilers.

3.3 TRAINING OF OWNER'S PERSONNEL

A. **Certified Installation**: The HVAC Contractor shall be a certified to install and start-up boilers per approved manufacturer's prior training.

B. **Start-Up Services**: Contractor shall provide factory-certified supervision of all phases of boiler installation and start-up services.

1. Furnish factory-certified installation compliance and start-up report at completion of project.
2. Provide factory training for Owner’s maintenance personnel on the operation and maintenance of the boiler system.

C. Schedule training with Owner, provide at least 7-day notice of Owner and Architect of training date.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. This section includes requirements for water treatment related to the following:
   1. Closed Loop Treatment System
   2. Pipe Cleaning and Inhibiting Treatment
B. Specification of an item in this section shall not relieve the HVAC Contractor from providing all items, materials, operations, methods, labor, equipment and incidentals necessary for a complete and functional system.
C. All services will be performed by a qualified, full-time representative of the water treatment company.

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 shall govern work under this section.
B. Specified Elsewhere:
   1. 23 06 00 Pipe and Pipe Fittings

1.3 SUBMITTALS
A. Submit product data, installation and operating instructions.

1.4 SUPERVISION AND INSPECTION
A. Water treatment manufacturer or his qualified representative to provide supervision and final inspection upon completion of installation and adjustment, shall submit report in writing, certifying the correctness of the installation in compliance with the specifications and proper operation.

PART 2 - PRODUCTS

2.1 CLOSED LOOP TREATMENT SYSTEM
A. Water treatment consists of initial chemical type treatment to clean piping and prevent rust and scale in final fill treated water.
   1. Sequestering agent to reduce deposits and adjust pH.
   2. Corrosion inhibitors.
   3. Conductivity enhances.

PART 3 - EXECUTION

3.1 INSTALLATION
A. Heating Contractor will provide initial fill treatment to each closed-loop system. After this initial treatment, the Owner shall be responsible for all future service requirements.
B. Furnish start-up chemical treatment chemicals, procedures and certification after installation is complete.
C. After start-up treatment, the treatment company shall be responsible for all water treatment service requirements for one year, to include the following treatment services performed by qualified, full time representatives of the treatment company.

1. Initial water analysis and recommendations.
2. Initial equipment clean-up chemicals, procedures and certification after clean-up is complete.
3. Assistance during start-up of the treatment program.
4. Instructions of operating personnel on proper feeding and control techniques.
5. Periodic service and consultation meetings.
6. Any necessary record forms and log sheets.
7. Any required laboratory and technical assistance.

3.2 PIPE CLEANING AND INHIBITING GUIDELINES

A. Cleaning: Hydronic water piping system shall be cleaned by using a solution consisting of a blend of organic alkaline penetrants, emulsifiers, surfactants and corrosion inhibitors and containing propylene glycol, methyl ether, phosphonates, sodium-meta-silicate-hydrate and sodium hydroxide.

1. The material shall not contain tri-sodium phosphate.
2. The piping system shall be filled, vented and circulated employing the chemical cleaner solution for a period of at least 24 hours or more in accordance with the manufacturer's recommendations and job site chemical tests. Water filters shall be removed from the system for this cleaning. The concentration shall be brought to a level which raises the M Alkalinity to a value of 250 above that for the existing water used for the fill.
3. Chemical tests shall be made to verify these levels and submitted to the A/E. The system should be circulated, drained and flushed to achieve the original M Alkalinity level.

B. Inhibitor:

1. The inhibitor shall be added to the system after it is acceptably cleaned and flushed and refilled. The inhibitor shall consist of a boron nitrite, benzol thiazol, benzotriazole, mercapto-benzo-thiazole, tolyltriazole silicates and color trace all producing a scale and corrosion inhibitor system. The inhibitor shall be chemically installed to a concentration of 700 to 1000 parts per million and the solution shall be tested to indicate that it falls within this range.
2. Test results shall be submitted to the A/E.
3. The strainer baskets may be remounted before the system is inhibited.

C. Supervision:

1. The chemical supplier shall supervise the addition, the testing of the flushing and draining of all chemical scale and inhibitor solutions for all systems. Three copies of the chemical water status shall be submitted to the A/E for final approval.
2. Cleaning, inhibiting and testing of the piping systems shall be carried out in the presence of the owner's representative.

END OF SECTION
SECTION 23 7400
TERMINAL AIR DISTRIBUTION UNITS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Extent of terminal air distribution unit equipment work is indicated by drawings and schedules, and by requirements of this section.
B. Types of terminal air distribution unit equipment required for project include the following:
   1. VAV Boxes with reheat.
C. Refer to other Division 23 temperature control system sections for control work required in conjunction with air distribution equipment.

1.2 RELATED DOCUMENTS
A. Applicable provision of Division 1 governs work under this section.
B. Specified Elsewhere:
   1. 23 05 90 Testing, Adjusting and Balancing
   2. 23 06 30 Piping Specialties
   3. 23 25 00 Mechanical Insulation
   4. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE
A. IBR Compliance: Provide terminal heating units bearing the IBR Hydronics Institute Certified Rating Seal.
B. AMCA Compliance: Provide air distribution equipment bearing the Air Movement and Control Association, Inc. (AMCA) Certified Rating Seal.
C. UL Compliance: Provide air distribution equipment electrical components which have been listed and labeled by Underwriter Laboratories (UL).

1.4 SUBMITTALS
A. Submit shop drawings for all equipment including all data concerning dimensions, air flow capacities, sound ratings, unit pressure drop, finish and appropriate identification.
B. Submit certified sound data for both casing discharge and radiated sound levels from 125 thru 8000 Hz as tested in accordance with Air Diffusion Council (ADC) Test Standard 1062R4.

PART 2 - PRODUCTS

2.1 VARIABLE AIR VOLUME BOXES
A. General: Provide single-duct VAV boxes of size and arrangement as indicated on Drawings, and of capacities and having accessories as scheduled.
B. Housing: Factory assembled unit with welded 26-gauge galvanized steel casing, acoustically and thermally lined with 1” thick 3 PSF fiberglass with high-density facing. Leakage rate 2% maximum at 0.5 inch W.G. Insulation to be UL listed and meet NFPA 90A requirements.
   1. Provide bottom or side access panel for air valve.
2. Provide bottom or side access panel upstream and downstream of reheat coil. Access panel shall be large enough to allow proper cleaning of reheat coil without dismantling ductwork.

C. Air Valves: Air flow control device with integral actuator. Electronic volume regulator supplied by Temperature Control Contractor, factory or field installed. Integral flow ring sensor with taps and calibration chart to measure air flow with 10% regardless of inlet connections.

D. V.A.V. Box Control: DDC/Electronic actuators, sensor wiring and application-specific controller supplied by Temperature Control Contractor, field-installed.

F. Hot Water Coil: Performance and rated capacities as indicated on schedules on Drawings.

1. Hot water coil with aluminum fins mechanically bonded to 5/8" OD seamless copper tube. Same end connections.
2. Coil leak tested at 300 PSIG air pressure, under water.
3. Provide duct extensions for access panel installation upstream of reheat coil to clean coil surface.

G. Acceptable Manufacturers:

1. Enviro-Tec
2. Trane
3. Carnes
4. Titus

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which terminal air distribution units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TERMINAL AIR DISTRIBUTION EQUIPMENT

A. Install terminal air distribution equipment where indicated, in accordance with equipment manufacturers installation instructions, and with recognized industry practices to ensure that equipment complies with requirements and serves intended purposes.

1. Provided proper service clearance space for controls and damper actuators.
2. Provide duct access panels upstream and downstream of reheat coils.

B. Coordinate with other work, including ductwork, piping and control work as necessary to interface installation of terminal air distribution equipment with other work.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of terminal unit equipment, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, and then retest to demonstrate compliance. Replace equipment which cannot be satisfactorily corrected.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Extent of gas-fired heating unit equipment work is indicated by drawings and schedules, and by requirements of this section.
B. Types of gas-fired heating unit equipment required for project include the following:
   1. Gas-fired Radiant Heating Units
C. Refer to other Division 23 temperature control system sections for control work required in conjunction with gas-fired heating equipment equipment.

1.2 RELATED DOCUMENTS
A. Applicable provision of Division 1 governs work under this section.
B. Specified Elsewhere:
   1. 23 05 90 Testing, Adjusting and Balancing
   2. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE
A. AGA American Gas Association
B. ANSI Z83.4 Direct Gas Fired Makeup Air Heaters
C. GAMA Gas Appliance Manufacturers Association
D. NEC National Electrical Code
E. UL Compliance: Provide air distribution equipment electrical components, which have been listed and labeled by Underwriter Laboratories (UL).

1.4 WARRENTY
A. Radiant heat tubes warranted against internal corrosion for 10 years. Remainder of infrared radiant heater components warranted for 1 year from date of startup.

1.5 SUBMITTALS
A. Submit shop drawings for all equipment including all data concerning dimensions, air flow and heating capacities, sound ratings, unit pressure drop, cabinet construction, finish and appropriate identification.

PART 2 - PRODUCTS

2.1 GAS-FIRED RADIANT HEATING UNITS
A. The entire system shall be AGA certified “Gas Infrared Heaters” conforming to ANSI standard Z83.6. All wiring shall comply with the National Electrical Code.
   1. System configuration and performance as indicated on the drawings and/or equipment schedules.
B. Overall system and sub-systems certified for use with [natural]propane gas, as indicated on the drawings. Each comprised of burner unit, outside air inlet, combustion pipe, radiant pipe, reflectors, support brackets, vacuum fan(s) (separate from burner unit), exhaust pipe, thermostats and safety controls.

1. Provide gas regulator, automatic gas valves and safety interlocks on gas train.
2. Unit is to be non-condensing type.

C. Burner and associated controls shall include, direct spark ignition, electronic flame monitoring, "power on" and "burner on" indicator lights, 100% gas safety shutoff in case of ignition failure, pre purge and post purge of system and air flow switch to prove combustion air flow prior to firing burner.

D. The combustion pipe shall be constructed of 16 gauge aluminized steel for a minimum of 10'. The radiant pipe shall be constructed of spiral wound 22 gauge aluminized steel. Construct flexible connector between vacuum fan and pipe of stainless steel.

E. Direct drive 115 volt combustion fan to exhaust all combustion gases to the outdoors.

F. Provide polished aluminum or polished stainless steel reflectors over all heat exchanger piping including elbows, u-bends and fittings.

G. Provide single point 115v power connection at burner unit. Vacuum fan power to be field wired to burner. (Power wiring by Division 26 00 00 - Electrical contractor. Thermostat and control wiring by this contractor)

H. Furnish a low voltage or 115 volt wall mounted thermostat. If low voltage is used then proved factory installed control transformer.

I. Approved Manufacturers:

1. Detroit Radiant Products Co.(Re-Verber-Ray).
2. Roberts-Gordon (Co-Ray-Vac).
4. Ambi-Rad.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which gas-fired heating units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF GAS-FIRED HEATING UNITS

A. Install gas-fired heating units where indicated, in accordance with equipment manufacturers installation instructions, and with recognized industry practices to ensure that equipment complies with requirements and serves intended purposes.

B. Coordinate with other work, including recessed wall installations, floor-mounted construction, and control work as necessary to interface installation of gas-fired heating units with work of other Trades.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of gas-fired heating unit equipment, test equipment to demonstrate compliance with requirements. Where possible, field correct malfunctioning equipment, then retest to demonstrate compliance. Replace equipment, which cannot be satisfactorily corrected.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Rooftop air conditioning unit completely factory assembled, installed on a prefabricated roof curb as indicated on drawings and schedules, and by requirements of this section.

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 shall govern work under this section.

1.3 QUALITY ASSURANCE
A. Installers: Contractor certified for installation of roof-top units, of types and capacities required, with similar installations in satisfactory use in similar service for not less than 3 years.

B. Regulatory Requirements:
3. ARI 270: Sound Rating of Outdoor Unitary Equipment.
4. UL Label: Provide ancillary electrical components which have been listed and labeled by Underwriters Laboratories.
5. UL 1995.
6. ANSI Z21.47

1.4 SUBMITTALS
A. Shop drawings of product data and manufacturer's installation and maintenance manual.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Base Bid: AAON
B. Alternate Bid: Reznor, Carrier, Daikin or Johnson Controls

2.2 PACKAGED ROOFTOP UNIT
A. Units shall be factory assembled, including starters, piped, internally wired, fully charged with R-410a and tested. All units are designed to operate at outdoor ambient temperatures as high as 120 degrees F. Cooling capacities are rated in accordance with ARI standards.

B. Casing panels are 20-gauge steel, double-wall construction with casketed and insulated with one-inch foamed panel, minimum R13 insulation value. Provide enamel finish on casing.

C. Refrigeration controls include condenser fan, evaporator fan and compressor contactors, and 24 volt transformer. Each circuit of the unit has a separate set of refrigeration controls.

D. Units have 3,600 RPM hermetic scroll compressors equipped with over temperature over current and high pressure controls and crankcase heaters. Include five year warranty.

E. Evaporator coils shall be seamless copper tubing mechanically bonded to aluminum fins and are factory pressure and leak tested at 225 PSIG.
F. Evaporator fan shall be belt driven, backward inclined, centrifugal type fans equipped with adjustable motor sheaves for belt driven units. The motor shall have thermal overload protection with permanently lubricated fan and motor bearings. Fan drive components shall be mounted on rubber-in-shear isolators to reduce noise and vibration.

G. Condenser fans shall be direct drive, statically and dynamically balanced propeller fans. Weatherproof fan motors with UL listing for outdoor use. Permanently lubricated motors with built-in thermal overload protection.

H. Gas heating Section: stainless steel heat tubular heat exchanger with turbulators, electronic igniter pilot system and induced draft blower. 15-year prorated warranty on heat exchanger. Modulating or staged gas valves as scheduled.

I. Filters shall be two inch throwaway 30% efficiency MERV 8 filters.

2.3 ACCESSORIES

A. As scheduled on the Drawings.

B. VFD-driven supply fan with premium efficiency motor, as scheduled.

C. VFD-driven exhaust/relief fan with premium efficiency motor, as scheduled.

D. Integral differential dry bulb economizer.

E. Digital scroll compressor for variable capacity cooling.

PART 3 - EXECUTION

3.1 GENERAL

A. Install rooftop unit complete on curb as per manufacturers installation instructions. Attach ductwork and controls as per plans and specifications.

B. Manufacturer representative shall assist with start-up and provide start-up report with acceptance of unit as installed and operating per the manufacturer’s recommendations.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Direct-fired, Indoor Make-up Air Units.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified elsewhere:

1. 23 05 90 Testing, Adjusting and Balancing
2. 23 90 00 Controls and Instrumentation
3. 23 96 00 Starting of Mechanical Systems

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Reference Standards:
   AGA American Gas Association
   ANSI Z83.4 Direct Gas Fired Makeup Air Heaters
   ANSI Z83.6 Gas Fired Infrared Heaters
   ANSI Z21.64 Direct Vent Central Furnaces
   GAMA Gas Appliance Manufacturers Association
   NEC National Electrical Code

B. WARRANTY:

1. Gas-fired primary and secondary heat exchangers warranted for 20 years under normal use and maintenance.
   Remainder of heating components warranted for 1 year from date of startup

1.5 SUBMITTALS

A. Refer to division 1, General Conditions, Submittals.

B. Submit complete product data, manufacturer's installation instructions and accessories required for complete system.

PART 2 - PRODUCTS

2.1 DIRECT-FIRED MAKE-UP AIR UNITS

A. Furnish fully assembled and wired gas-fired direct-fired make-up air units in the size and capacity as shown on the Drawings.

B. Furnish fully assembled and wired direct-fired outdoor make-up unit with blower/filter section, and duct furnace section in the size and capacity as shown on the Drawings and specified herein. Designed for 100% make-up air applications with ETL certified compliance with ANSI Standard Z83.18 and Z83.4.

C. Casing: Shall be complete with insulated double-wall, galvanized steel construction in weatherized cabinet, hinged side panels, filters (2" 30% - MERV 8) and filter rack. Unit shall be configured for indoor horizontal discharge with rail mounting. Access panels shall employ locking cams with tool-less door access handles to access equipment.
D. Bonnet Section: AGA certified and constructed of AGA defined corrosion resistant material with a built-in draft diverter. Burners shall be cast iron construction with stainless steel mixing plates. Burner shall employ an electronic modulating gas design for 25:1 turndown ratio.

E. Blower Section: Shall be factory installed with NEMA standard motor, IEC contactor or starter, dynamically-balanced class I or II centrifugal blower fan and adjustable belt drive.

F. Gas Train:
   1. Units shall be provided with gas valves suitable for Class 2, maximum inlet pressure of 0.5 psi (14 inch W.C.) on natural gas.
   2. The 24-volt combination automatic gas valves must include a main operating valve, pilot safety shutoff, pressure regulator, manual main and pilot shutoff valve, and adjustable pilot valve.
   3. Gas valves shall be electronic modulating gas valve. Ignition shall be at full fire (100% input) and modulate the gas input from 100 to 4% rated input. Gas valve shall be energized through duct thermostat control with reset from the space selector thermostat. Maxitrol Series 14 amplifier or approved equal.

G. Controls:
   1. A factory installed control box or junction box shall be provided for all power connections. A 24-volt control transformer, high limit, and fan time delay relay must be provided. Fan time delay relay will delay the fan start until the heat exchanger reaches a predetermined temperature and allow the fan to operate after burner shutdown to remove residual heat from the heat exchanger.
   2. A solid-state ignition control system shall ignite the pilot by spark during each cycle of operation. When pilot flame is proven, main burner valve shall be open to allow gas flow to burner. Pilot and burners must be extinguished during the off cycle.

H. Accessories: (Refer to Schedules for further requirements)
   1. Low voltage duct thermostat, modulating control and remote control station as scheduled for discharge air temperature control.
   2. 120 volt/1-phase electric service with control transformers.
   3. Indoor filter section with locking access door.
   4. Double-wall construction.
   5. Painted enamel finish.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with all applicable codes, standards and local utility requirements. Install units per manufacturer’s instructions.

B. Connect natural gas line to gas-fired equipment and adjust pilot flame, gas input and pressure per manufacturer's recommendations.

C. Install and adjust integral and remote temperature controls for proper operation.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of fan work is shown on drawings and schedules, and by requirements of this section.

B. Types of fans required for project include the following:
   1. Centrifugal Inline Fans.
   2. Ceiling Mounted Fans.
   3. Wall Fans.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:
   1. 23 05 90 Testing, Adjusting and Balancing
   2. 23 20 00 Vibration Isolation
   3. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

A. Manufacturers:
   1. Greenheck
   2. Carnes
   3. Cook

B. AMCA Compliance: Provide fans bearing the Air Movement and Control Association, Inc. (AMCA) Certified Rating Seal.

C. UL Compliance: Provide power roof ventilator electrical components which have been listed and labeled by Underwriters Laboratories (UL).

1.4 SUBMITTALS

A. Submittals shall include all product data, performance, materials of construction, and installation instructions.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL INLINE FANS

A. Centrifugal inline fans shall be the belt or direct-driven, centrifugal type, as schedule.

B. The fan wheel shall be centrifugal with backward inclined, airfoil, or forward curved blades, as scheduled. The fan wheel shall be statistically and dynamically balanced. The fan shall be quiet operating and vibration free. Fan performance shall be certified by an AMCA ratings seal.

C. The fan shaft shall be mounted in lubricated ball bearing pillow blocks. Bearings shall be provided with grease fittings and caps. Bearings shall be rated for 200,000 hours.

D. The fan housing shall be steel construction. Belt drives shall have a sliding or pivoting motor plate for belt tensioning, and the belt shall be totally enclosed by a belt guard with tachometer holes. The fan motor shall be a NEMA approved, ball bearing type. Provide casing access for checking fan speeds. Provide variable-speed control switch when scheduled.

E. Accessories: As specified herein and indicated on drawings schedules:
   1. Spring vibration isolation supports.
2. ECM motor with remote 0-10VDC input control.
3. Flexible duct connections.

2.2 CEILING MOUNTED FANS

A. Ceiling Mounted: Furnish ceiling-mounted exhaust fans complete with centrifugal blower, inlet grille, gravity back-draft damper, and discharge duct connection as shown on the drawings. Fan shall be AMCA certified with a sound rating of less than 4.5 sones. Housing shall be insulated with minimum 1/2" acoustic insulation.
   1. Accessories (as indicated on plans and schedules).

2.3 WALL EXHAUST FANS

A. Provide direct or belt driven propeller type wall mount exhaust fans as scheduled on drawings.
   1. Accessories (as indicated on plans and schedules).
B. Fans shall be complete with wall sleeve, fan guard and motorized or gravity backdraft damper.
C. The fan shall be quiet operating and vibration free. Fan performance shall be certified by AMCA ratings seal. The fan shaft shall be mounted in permanently lubricated ball bearing pillow blocks.
D. The fan motor shall be a NEMA approved, ball bearing with type with thermal overloads. Belt drives shall be adjustable, and the entire drive assembly shall be mounted on neoprene vibration isolators.

PART 3 - EXECUTION

3.1 INSPECTION

A. General: Examine areas and conditions under which fans are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF FANS

A. General: Except as otherwise indicated or specified, install ventilators in accordance with manufacturer's installation instructions and recognized industry practices to insure that ventilators serve their intended function.
B. Coordinate ventilator work with work of roofing, walls and ceilings, as necessary for proper interfacing.
C. 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.
   1. 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.
D. Install vibration isolation as scheduled and specified in Section 23 20 00.

3.3 FIELD QUALITY CONTROL

A. Testing: After installation of ventilators has been completed, test each ventilator 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.

3.4 SPARE PARTS

A. General: Furnish to Owner, with receipt, one spare set of belts for each belt drive power ventilator.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of energy recovery ventilation equipment work is indicated by drawings and schedules, and by requirements of this section.

B. Types of energy recovery ventilation equipment required for project include the following:

1. Indoor static plate enthalpy recovery type

C. Refer to other Division 23 temperature control system sections for control work required in conjunction with energy recovery ventilator equipment.

1.2 RELATED DOCUMENTS

A. Applicable provision of Division 1 governs work under this section.

B. Specified Elsewhere:

1. 23 05 90 Testing, Adjusting and Balancing
2. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE

A. Reference Standards:

1. NFPA 90A Standard for Installation of Air Conditioning and Ventilating Systems
2. CSA 22.2
3. UL 1812
4. AMCA 210
5. ASHRAE 84-78P
6. ARI 1060 standards

B. UL Compliance: Provide air distribution equipment electrical components, which have been listed and labeled by Underwriter Laboratories (UL).

1. Manufacturer shall be able to provide evidence of independent testing of the core by Underwriters Laboratory (UL), verifying a maximum flame spread index (FSI) of 25 and a maximum smoke developed index (SDI) of 50 thereby meeting
2. NFPA 90A and NFPA 90B requirements for materials in a compartment handling air intended for circulation through a duct system. The method of test shall be UL Standard 723.
3. Unit shall be Listed under UL 1812 Standard for Ducted Air to Air Heat Exchangers. Some exceptions to UL Listing may apply.

C. The energy recovery cores used in these products shall be third party Certified by AHRI under its Standard 1060 for Energy Recovery Ventilators. AHRI published certifications shall confirm manufacture’s published performance for airflow, static pressure, temperature and total effectiveness, purge air (OACF) and exhaust air leakage (EATR). Products that are not currently AHRI Certified will not be accepted.

1.4 WARRANTY

A. The ERV core shall be warranted to be free of manufacturing defects and to retain its functional characteristics, under circumstances of normal use, for a period of ten years from the date of purchase.
B. The balance-of-unit shall be warranted to be free of manufacturing defects and to retain its functional
characteristics, under circumstances of normal use, for a period of two years from the date of purchase.

1.5 SUBMITTALS

A. Refer to division 1, General Conditions, Submittals.

B. Submit shop drawings for all equipment including all data concerning dimensions, air flow capacities, sound
ratings, heat recovery performance and appropriate identification.

PART 2 - PRODUCTS

2.1 AIR-TO-AIR HEAT EXCHANGERS (Static Plate Enthalpy Recovery Type)

A. MANUFACTURERS:

1. RenewAire.
2. Approved equal.

B. GENERAL: Indoor draw-through energy recovery unit consisting of a static plate enthalpy heat exchanger,
ventilation air supply fan and exhaust air fan, unit electrical wiring and related control wiring

C. Unit Cabinet: Cabinet shall be single-walled constructed of 20-gauge G90 galvanized steel, insulated with
minimum Rv4 foil-faced rigid insulation. The working components shall be fully accessible by a fully hinged
access doors.

D. HEAT EXCHANGER CORE: Enthalpic heat exchanger core shall consist of laminar flow, fixed-media, cross-flow
construction with no moving parts. Latent energy transfer shall be accomplished by direct water vapor transfer
through molecular transport. Exhaust and fresh air streams shall be separated and not mix. Heat exchanger
core shall not require defrost control or condensate removal.

1. The ERV core shall perform without condensing or frosting under normal operating conditions
(defined as outside temperatures above -10°F and inside relative humidity below 40%).
Occasional more extreme conditions shall not affect the usual function, performance or
durability of the core. No condensate drains will be allowed.

E. FANS: Fans shall be DWDI forward-curved, belt or direct-driven with internal vibration isolation, if specified. Unit
shall be constant volume air units operating at the specified external static pressure.

F. MOTORS: Motors shall have characteristics consistent with the torque and speed of the fans being driven. All
motors shall be NEMA frames and be rated in accordance with NEMA performance standards for continuous full
load performance at 40 degrees C temperature rise above ambient, with a 1.15 service factor. Motor horsepower
and voltages shall be as scheduled.

1. The motor furnished with the fan shall not operate into the motor service factor.
2. Furnish NEMA EPACT premium-efficiency motors.
3. Furnish ECM controlled motors, where scheduled, allowing for to preset speeds or variable
speed operation with a 0-10 volt DC control signal, where scheduled on the Drawings.

G. FILTERS: Furnish 2" pleated MERV 8 filters and filter track on both entering air sides of unit. Filter rack may be
integral with unit or installed independently in duct upstream of unit.

H. CONTROLS: All unit controls shall be factory wired so that only field connections are required. Unit shall provide
terminal connections for fan interlock with air handling unit operation and dirty filter signal.

1. IBC - Independent Blower Control: Provide dual fan contactors for independent supply and exhaust fan
control for economizer operation.
2. Provide 24 volt control relay-transformer for 208-volt/3-phase service.
I. ELECTRICAL: Single point power connection.

1. Electric Service: 120-volt, 1-phase or 208-volt, 3-phase; as scheduled on the Drawings.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units in accordance with unit manufacturer’s installation requirements in locations indicated on the drawings and as detailed.

3.2 ENERGY RECOVERY VENTILATORS

A. Support or suspend the unit with proper mounting arrangement and connect with flexible duct connections.

B. Coordinate low-voltage controls with the Temperature Control Contractor.

C. Verify unit and fan controls are operating properly. Interlock unit operation with associated air handler for occupied ventilation operation.

D. Confirm fan is operating in the correct rotation. Verify filters and cores are installed properly. Arrange for filter gauges and related accessories to be installed.

E. Coordinate ERV final balance work the TAB Contractor.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of ductwork requirements is indicated on the Drawings and by requirements of this section.

B. The ductwork requirements for this project include the following:

1. Low-Pressure Ductwork
2. High-Pressure Ductwork
3. Plenums
4. Flexible Ductwork.
5. Acoustic Duct Lining.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

1. 23 25 00 Mechanical Insulation
2. 23 86 00 Ductwork Accessories

1.3 QUALITY ASSURANCE


1.4 SUBMITTALS

A. Submit product data and specifications for ductwork materials.

B. Indicate duct fittings, particulars such as gages, sizes, welds, and configuration prior to start of work for low and high-pressure and exhaust ductwork systems.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect Ductwork by storing inside or by durable, waterproof, above ground packaging. Do not store material on grade. Protect Ductwork from dirt, dust, construction debris and foreign material. Where end caps/packaging are provided, take precautions so caps/packaging remain in place and free from damage.

B. Offsite storage agreements do not relieve the contractor from using proper storage techniques.
PART 2 - PRODUCTS

2.1 DUCTWORK MATERIALS

A. Above ground, general ductwork: Galvanized steel, lock-forming quality, ASTM A527; 1.25 oz. zinc coating each side, mill phosphatized, ASTM A525.

1. Round – Spiral wound ductwork.

B. Steel Ducts: Galvanized steel, lock-forming quality, ASTM A527; 1.25 oz. zinc coating each side (G90), mill phosphatized, ASTM A525.

C. Stainless Steel Ducts: ASTM A167, Type 304.

D. Flexible Duct:


E. Insulated Flexible Duct: Insulation shall be cellular glass, 1-1/2" nominal thickness of 1-1/2 pound density per cubic foot. The insulation shall encase the flexible duct and shall be sheathed with vapor barrier having a permeability of not over 2.0 perm. Insulation and vapor barrier shall be factory installed.

F. Flexible Fiberglass Duct Liner: Flexible coated glass fiber duct liner; ANSI/ASTM C553; 'K' value of 0.26 at 75 degrees F; 1-1/2 lbs./cu. ft. minimum density; coated air side for maximum 4,000 ft./min. air velocity.


2. Impale Anchors: Galvanized steel, 12 gage self-adhesive pad or mechanical fastener type as recommended, insulation manufacturer.

G. Duct Sealant: Non-hardening, non-migrating mastic or liquid elastic sealant gaskets and tapes as compounded and recommended by the manufacturer specifically for sealing joints and seams in ductwork.

H. Ductwork Support Materials: Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

I. Drive Screws and Clamps: As recommended by SMACNA.

J. Factory Made Joints: Ductmate system as manufactured by Ductmate Industries, Inc., Nexus system as manufactured by Exanno, or other approved product may be used.

2.2 DUCTWORK PRESSURE-VELOCITY CLASSIFICATION


B. Low Pressure Ductwork:

1. Static Pressure Class: +2" W.G.

2. Maximum Velocity Level: 2500 FPM.

C. High Pressure Ductwork:

1. Static Pressure Class: +4" W.G.

2. Maximum Velocity Level: 4000 FPM.

2.3 DUCTWORK SEALING CLASSIFICATION

B. Low Pressure Ductwork:
   1. Seal Class: B - seal transverse joists and longitudinal seams.

C. High Pressure Ductwork:
   1. Seal Class: A - seal transverse joints and longitudinal seams and ductwall penetrations.

2.4 FABRICATION

A. Shop fabricate ductwork in 4, 8, 10, or 12 foot lengths, unless otherwise indicated or required to complete runs. Pre-assemble 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 reassembling and coordinated installation.

B. All dimensions indicated on drawings are free area ductwork requirements. Increase ductwork dimensions to accommodate ductwork lining requirements.

C. Accessories:
   1. Fabricate ductwork with accessories such as air turns, extractors, and volume dampers, installed during fabrication to greatest extent possible.
   2. Fabricate ductwork with duct liner in each section of duct where required.

D. Variation: No variation of duct configuration or sizes permitted except by written permission.

E. Directional Change:
   1. Construct tees, bends, and elbows with radius minimum 1-1/2 times width of duct on center lines.
   2. Where not possible and where rectangular elbows used, provide airfoil type turning vanes.
   3. Where acoustical lining is required, provide turning vanes of perforated metal type with fiberglass inside.

F. Size Change:
   1. Increase duct sizes gradually, not exceeding 15 deg. divergence wherever possible.
   2. Maximum divergence upstream of equipment to be 30 deg. and 45 deg. convergence downstream.

G. Seams and Joints:
   1. Seams and joints fabricated in accordance with SMACNA standards.
   2. Rigidly construct metal ducts with joints mechanically tight, substantially airtight, braced and stiffened so not to breathe, rattle, vibrate, or sag.

2.5 LOW PRESSURE DUCTWORK

A. Fabricate and support in accordance with SMACNA Low Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts. No variation of duct configuration or sizes permitted except by written permission.

C. Construct T’s, bends, and elbows with radius of not less than 1-1/2 times width of duct on center line. Where not possible and where rectangular elbows are used, provide airfoil turning vanes. Where acoustical lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.
   1. Where acoustic lining is indicated, provide turning vanes of perforated metal with glass fiber insulation.

D. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible. Divergence upstream of equipment shall not exceed 30 degrees; convergence downstream shall not exceed 45 degrees.
E. Provide easements where low pressure ductwork conflicts with piping and structure. Where easements exceed 10 percent duct area, split into two ducts maintaining original duct area.

F. Connect flexible ducts to metal ducts with adhesive and draw bands.

G. **Round Duct Take-Offs:** Provide conical or bellmouth low-pressure fittings.

H. **Square Duct Take-Offs:** Provide 45 degree leading edge at square take-off with 4: minimum depth.

### 2.6 HIGH PRESSURE DUCTWORK

A. Fabricate and support in accordance with SMACNA High Pressure Duct Construction Standards and ASHRAE handbooks, except as indicated. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Construct T's, bends, and elbows with radius of not less than 1-1/2 times width of duct on centerline. Where not possible and where rectangular elbows are used, provide airfoil-turning vanes. Where acoustical lining is required, provide turning vanes of perforated metal with glass fiber insulation. Weld in place.

C. Transform duct sizes gradually, not exceeding 15 degrees divergence and 30 degrees convergence.

D. Fabricate continuously welded medium and high pressure round and oval duct fittings as indicated in SMACNA Standard. Joints shall be minimum 4-inch cemented slip joint, brazed or electric welded. Prime coat welded joints.

E. Round or flat oval type ducts shall be constructed with lock tight spiral seams, gored elbows with centerline radius of 1-1/2 times the duct diameter and male/female fittings.

F. **Take-Offs:** Conical tees, conical 45 degree laterals, conical bellmouth taps and fittings shall be used. Seal all joints airtight with gaskets and mastic sealants.

G. Fabricated rectangular ducts shall be constructed with companion angle flanged joints secured to duct walls. Use continuous closed cell gasket at joints with snap-on cleats and corner bolts. Provide 45-degree close openings at takeoffs and corners. Seal all joints air tight with gaskets and mastic sealants.

### 2.7 DUCTWORK APPLICATION SCHEDULE

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</tr>
<tr>
<td>Return air - to AHU's:</td>
<td>Low Press</td>
<td>Steel</td>
</tr>
<tr>
<td>Supply air - VAV boxes to outlets:</td>
<td>Low Press</td>
<td>Steel</td>
</tr>
<tr>
<td>Exhaust air:</td>
<td>Low Press</td>
<td>Steel</td>
</tr>
<tr>
<td>Fresh air:</td>
<td>Low Press</td>
<td>Steel</td>
</tr>
</tbody>
</table>

### 2.8 ACOUSTIC DUCT LINING APPLICATION SCHEDULE

<table>
<thead>
<tr>
<th>Air System</th>
<th>Thickness</th>
</tr>
</thead>
<tbody>
<tr>
<td>Transfer Ducts - Square or rectangular:</td>
<td>1&quot;</td>
</tr>
<tr>
<td>Supply Ducts - Downstream of VAV boxes 10 feet</td>
<td>1&quot;</td>
</tr>
</tbody>
</table>

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

A. Assemble and install ductwork in accordance with SMACNA standards, and which will achieve airtight and noiseless systems, capable of performing each indicated service.

1. Align ductwork accurately at connections.
2. Support ducts rigidly with suitable ties, braces, hangers and anchors of type, which will hold ducts straight, plumb and free of sags and vibration.
B. **Electrical Equipment Spaces:** Do not run ductwork through transformer vaults and other electrical equipment spaces and enclosures.

C. **Metal Duct Support:**

1. Support ductwork from building structure as required and, where not otherwise indicated, anchor with bolts, concrete inserts, steel expansion anchors, welded studs, C-clamps or special beam clamps.
2. Support vertical ducts, at 12 foot spacing, by attachment to adjacent vertical structural surfaces or by direct bearing at floor penetrations and similar locations.
3. Support horizontal ducts located against structural walls and other similar adjacent vertical surfaces, at 8 foot spacing for ducts up to 40 inches horizontal dimension and 4 foot spacing for larger ducts.
4. Hang horizontal rectangular ducts from overhead structure, at 10 feet spacing for duct widths up to 60 inches and 8 foot spacing for larger ducts.
5. Arrange hangers, supports and duct rests to permit free, unrestrained and noiseless expansion and contraction of duct.
6. Where duct lining not used, vertical members may be fastened to duct sides with sheet metal screws.
7. Where duct lining is used, do not puncture sheet metal.

D. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.

E. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

F. Slope underground ducts to plenums or low pumpout points at 1:100 feet. Provide access doors for inspection.

G. Connect terminal units to high-pressure ducts directly with three-foot maximum length of flexible duct. Do not use flexible duct to change direction.

H. Provide residue traps in kitchen hood exhaust ducts at base of vertical risers with provisions for cleanout.

I. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

J. Provide sleeved opening where ducts pass through smoke, fire and sound walls.

1. Seal space between duct and sleeve airtight with mineral wool or approved fire stopping material.
2. Provide duct flange to cover and retain fire-stopping material.

K. **Connections:**

1. Connect duct to equipment with flexible fabric, sheet metal clips, screws and washers.
2. Connect branch take-offs to include prefabricated air scoops formed of same material as associated duct system.
3. Connect diffusers or plenum boots to low-pressure ducts with 10-foot maximum length of flexible duct, held in place with strap or clamp.

L. **Flexible Ductwork:**

1. Do not exceed 6 feet in length in accordance with NFPA 90.
2. Install flexible ductwork with minimum offsets and trim.
3. Connect with factory-installed compression coupling each end or provide separate adjustable bond and clamp to secure duct to trunk fitting and to distribution unit fitting.
4. Where recommended by manufacturer, make connections with mastic duct tape and adjustable clamp.

3.2 **DUCT LEAKAGE**

A. Inspect all ductwork for leak sources and repair.

B. Do not insulate ductwork until it has been accepted for duct leakage.
C. Refer to Section 23 05 90 for Testing, Adjusting, and Balancing requirements of ductwork system.

D. Low pressure ductwork leakage rate shall not exceed 5%.

E. High pressure ductwork leakage rate shall not exceed 2%.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of duct accessories work is indicated on drawings and in schedules, and by requirements of this section.

B. Types of duct accessories required for this project include the following:

1. Dampers:
   a. Manual dampers
   b. Control dampers
2. Fire dampers
3. Turning vanes
4. Duct hardware
5. Duct access panels
6. Flexible connections

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

1. 23 25 00 Mechanical Insulation
2. 23 84 00 Ductwork
3. 23 90 00 Controls and Instrumentation

1.3 QUALITY ASSURANCE


B. Industry Standards: Comply with American Society of Heating, Refrigerating and Air Conditioning Engineers Inc. (ASHRAE) recommendations pertaining to construction of duct accessories, except as otherwise indicated.

C. UL Compliance: Construct, test, and label fire dampers in accordance with Underwriters Laboratories (UL) Standard 555 "Fire Dampers and Ceiling Dampers".


PART 2 - PRODUCTS

2.1 DAMPERS

A. Manual Dampers: Provide dampers of single blade type (up to 6" height) or multiblade type (over 6" height), constructed in accordance with SMACNA Standards. Provide damper operator with locking devices and damper position indicator.

B. Automatic Control Dampers (ACD): Refer to Division 23 section "Controls and Instrumentation" for automatic control damper requirements. Furnished by Temperature Controls Contractor.

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering dampers which may be incorporated in the work include, but are not limited to the following:

1. Honeywell.
2. Vent Products.

2.2 FIRE DAMPERS

A. Fire Dampers: Provide 1-1/2 hour, Type 'B' UL listed fire dampers, of sizes indicated, unless indicated otherwise. Construct casing of 16 ga. galvanized steel with bonded red acrylic enamel finish. Provide fusible link as required. Provide damper with positive lock in closed position, and with the following additional features:

1. U.L. Listed Fire Rating: 1-1/2 hour
2. Damper Blade Assembly: Curtain type.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire and smoke dampers which may be incorporated in the work include, but are not limited to the following:

1. Air Balance Inc.
2. Safe Air Inc.

2.3 TURNING VANES

A. Manufactured Turning Vanes: Provide turning vanes constructed of 1.5" wide curved blades set at 1.5" spacing O.C., supported with bars perpendicular to blade set at 2" O.C., and set into side strips suitable for mounting in ductwork. Double wall type turning vanes shall be 2" radius, 2-1/8" spacing O.C.

1. Ducts over 24-inch dimension shall use double-wall airfoil type turning vane.
2. Ducts with air velocity over 2500 FPM shall use double-wall airfoil type turning vane.

B. Acoustic Turning Vanes: Provide acoustic turning vanes constructed of airfoil shaped aluminum extrusions with perforated faces and fiberglass fill.

1. Provide where acoustic duct liner is required.

2.4 DUCT HARDWARE

A. General: Provide duct hardware, manufactured by one manufacturer for all items on project, for the following:

1. Quadrant Locks: Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12". Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering duct hardware which may be incorporated in the work include, but are not limited to the following:

1. Ventfabrics, Inc.
2. Young Regulator Co.

2.5 DUCT ACCESS PANELS

A. General: Provide where indicated, duct access panels of size indicated. Minimum size 12" x 12". Access panels are required at the following equipment, but are not limited to these locations:

1. Upstream and downstream of reheat or duct-mounted coils.
2. Fire Dampers.
3. Backdraft and motorized dampers.
5. Louvers.
B. **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 size hinged, other side with one (1) handle-type latch for doors 1/2" high and smaller, 2 handle-type latched for larger doors.

C. **Available Manufacturers:** Subject to compliance with requirements, manufacturers offering duct access door which may be incorporated in the work include, but are not limited to the following:

1. Air Balance Inc.
2. Duro Dyne Corp.
4. Ventfabrics Inc.

2.6 **FLEXIBLE CONNECTIONS**

A. **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.

**PART 3 - EXECUTION**

3.1 **INSPECTION**

A. Examine areas and conditions under which duct accessories will be installed. Do not proceed with work until unsatisfactory conditions have been corrected.

3.2 **INSTALLATION**

A. Install duct 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.

B. Install turning vanes in square or rectangular 90 deg. elbows in supply and exhaust air systems, and elsewhere as indicated.

C. Install access doors to open against systems air pressure, with latches operable from either side, except outside only where duct is too small for person to enter.

D. Coordinate with other work, including ductwork as necessary to interface installation of duct accessories properly with other work.

1. Install control dampers provided by Temperature Control Contractor.

E. **Field Quality Control:** Operate installed duct 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 leak proof performance.

**END OF SECTION**
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SECTION 23 8700
AIR OUTLETS AND INLETS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Extent of outlets and inlets work is indicated by drawings and schedules, and by requirements of this section.
B. Types of outlets and inlets required for project include the following:
   1. Ceiling Diffusers
   2. Return & Exhaust Registers and Grilles
   3. Louvers

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 shall govern work under this section.
B. Specified Elsewhere:
   1. 23 84 00 Ductwork
   2. 23 86 00 Ductwork Accessories

1.3 QUALITY CONTROL
A. Manufacturers: Firms regularly engaged in manufacturer of outlets and inlets of types and capacities required, whose products have been in satisfactory use in similar service for not less than 5 years. Acceptable manufacturers are listed as follows:
   1. Carnes
   2. Titus
   3. Metal-Aire
   4. Krueger
   5. Price.
B. ARI Standards: Comply with Air Conditioning and Refrigeration Institute (ARI) Standard 650 "Air Outlets and Inlets".
C. ADC Standards: Comply with Air Diffusion Council standards.
D. MCA Standards: Comply with Air Moving and Conditioning Association standards.

1.4 SUBMITTALS
A. Submit shop drawings covering each item together with schedule of outlets and inlets.
B. Submit manufacturer's air diffusion performance data and installation instructions.

PART 2 - PRODUCTS

2.1 GENERAL
A. Except as otherwise indicated, provide manufacturers standard outlet and inlet products where shown, of size, shape, capacity and type indicated on schedules, constructed of materials and components as indicated, and as required for complete installation.
B. Performance: Provide outlet and inlet products that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturers current data and schedule for application.
C. **Ceiling Compatibility**: Provide outlet and inlet products with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems, which will contain each type of ceiling air diffuser.

### 2.2 CEILING DIFFUSERS

A. **Ceiling Diffusers**: Face panel and blades shall be constructed of galvanized steel with exposed surfaces finished in off-white or as scheduled. Diffuser shall have horizontal directional blades for airflow, round or square neck with opposed blade damper. Adjustable vertical or horizontal hinged blades, where scheduled.

1. Extruded aluminum construction.

B. Diffuser is designed to mount over T-bar suspended or surface mounted in plaster ceiling systems.

### 2.3 PERFORATED CEILING GRILLES

A. **Perforated Square**: Steel construction, perforated hinged face, T-Bar mounted, white finish with black interior. Square or round neck, as scheduled.

### 2.4 RETURN AND EXHAUST GRILLES AND REGISTERS

A. **Square and Rectangular**: Steel or extruded aluminum construction, 40 degrees fixed deflection, surface-mounted.

1. Opposed blade damper, as scheduled.
2. **Finish**: White.
3. Aluminum bar grilles, as scheduled.

### 2.5 SUPPLY REGISTERS

A. **Square and Rectangular**: Aluminum construction, double-deflection, streamlined bars spaced 1/2" O.C., 1 1/4" margin, and gasket seals.

1. Opposed blade damper, as scheduled.

### 2.6 LINEAR SLOT DIFFUSERS

A. **Insulated Plenum Slot Diffusers**: Steel construction, insulated plenum with linear slot diffusers for 1 or 2-way throw at ceiling. T-bar mounted or surface mounted with flanged frame.

1. Opposed blade damper, as scheduled.
2. **Finish**: White.
3. Notched center for 48 inch diffusers, as scheduled.
4. Provide center T-bar, as scheduled.

### 2.7 LOUVERS

A. **Stationary extruded**: Extruded aluminum 6063-T5 alloy construction, minimum section 0.080", stainless steel screw assembly with integral caulking recess. "S" blades 4" or 6" deep spaced on 4" centers set at 45 degrees with rainhook and 5/8" flanges at edges. Aluminum birdscreen 1/2" mesh on inside face.

1. Extended sills, where indicated.
2. **Finish**: Factory paint finish as scheduled, finish color selection by Architect.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

A. Coordinate with other work, including ceiling layout, ductwork and ductwork accessories, as necessary to interface installation of air diffusers properly with other work.
B. Install items in accordance with manufacturer's printed instructions.

C. Paint ductwork visible behind air outlets matt black.

D. **Diffusers:**
   1. At each duct drop or take-off to individual diffusers, locate extractor or scoop.
   2. Support diffusers adequately for type of ceiling receiving diffusers.
   3. Adjust diffuser air pattern as required to provide draft less uniform air distribution.

E. **Grilles and Registers:**
   1. Secure overlapping frame of register or grille to screen, flange, or angle of ductwork with countersunk screws.
   2. Locate wall registers and grilles minimum 6 inches below ceiling, unless otherwise indicated.
   3. Locate separate accessible balancing volume damper at each register or grille in addition to control damper integral with register or grille.
   4. Adjust registers and grilles to provide draft less uniform air distribution.

F. **Louvers:**
   1. Coordinate required wall openings with other trades.
   2. Turn over louver to General Contractor for installation.
   3. Verify proper opening requirement with General Contractor.
   4. Caulking and waterproofing by General Contractor.

3.2 **FIELD QUALITY CONTROL**

A. Test and operate installed outlets and inlets to demonstrate compliance with requirements.

**END OF SECTION**
PART 1 - GENERAL

1.1 DESCRIPTION

A. Work Includes:
   1. Complete system of Electronic Direct Digital Automatic Controls System.
   2. Electrical Control system.
   3. Control devices, components, wiring and material.
   4. Instructions for users.

1.2 DESCRIPTION OF WORK

A.Extent of controls and instrumentation work is indicated on drawings and schedules and by requirements of this section.
B. New DDC control system with network wiring with Web-based remote access and central TC workstation for routine maintenance access to control network. Coordinate LAN security and access address with Owner’s IT Contractor.
C. Control system for rooftop units and variable volume boxes with space sensor and reheat coils shall be electronic (DDC) to control HVAC systems as specified herein. Electronic controlled devices such as valve and damper actuators shall be employed. Control loop logic and sequencing of HVAC operations shall be accomplished by DDC controls with electronic input devices as temperature and pressure sensors.
D. Provide heating plant boiler reset, boiler enable, pump monitoring and control in conjunction with integrated boiler controls.
E. Control systems shall be electronic DDC to control valve and damper actuators for terminal units, as specified herein.
F. Rooftop unit RT-1 is factory supplied with duct-mounted smoke detector in return ductwork.
G. Instruction of Owner's personnel.

1.3 RELATED WORK

A. Applicable provisions of Division 1 shall govern work under this section.
B. Specified Elsewhere:
   1. 23 91 00 Direct Digital Control Systems
   2. 23 95 00 Control Sequence
   3. 23 90 10 DDC Point List

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. National Electrical Code, NEC
   2. National Electrical Manufacturers Association, NEMA
   3. Underwriter's Laboratories, UL
B. All equipment provided, including control panels, dampers, valves, controllers, transmitters, sensors and other control devices shall bear the manufacturer's nameplate.
C. Entire control system including piping and wiring shall be installed by mechanics specifically authorized by the Temperature Control equipment manufacturer for the installation and having acceptable experience installing and servicing similar control equipment.

1. Temperature Control Contractor shall have a minimum of 5 years experience installing control systems.
2. Contractor shall have authorized service personnel within 30 miles of the project.

D. Acceptable Manufacturers:

1. Honeywell.
2. Alerton.
3. Approved equal control manufacturers.

E. Guarantee: Guarantee the controls and instrumentation to maintain the temperature within one degree of the set point and further guarantee all work, materials, equipment, and controls against defects in workmanship and material, and provide service for a period of one (1) year from date of final acceptance.

1.5 SUBMITTALS

A. Shop Drawings:

1. Schematic control diagrams giving specific data on all settings, ranges, action, adjustments, and normal positions.
2. Wiring diagrams detailed adequately for field construction and include all related wiring.
3. Control valve and damper schedules with complete sizing data giving required design flow and temperature or pressure, and any other pertinent data.
4. Sequence of operation for each system corresponding to control schematics.
5. Panel drawings including complete internal wiring and piping schematics and complete data on all mounted components.
6. Damper operator schedule, listing quantity, size of operators and mounting arrangement.
7. Space thermostat sensor schedule indicating types of covers and adjustment means for each space.

B. Control Diagrams:

1. Furnish and mount in each equipment room or space prints of schematic control diagrams and corresponding sequences of operation for all systems located therein.
2. Diagrams and sequences mounted in frames under clear plastic and located in easily visible location or as directed by A/E.

C. Product Data:

1. Submit published descriptive data on each item of equipment and accessories.
2. Submit manufacturer's installation instructions.

D. Report:

1. At completion of work, submit report of checkout of automatic control system.
2. Report actual set points with record drawings.

1.6 CALIBRATION AND ADJUSTMENTS

A. After completion of the installation, perform final calibrations and adjustments of the control equipment provided under this contract and supply services incidental to the proper performance of the automatic control system under warranty.

B. Submit letter to Engineer indicating all controls are calibrated and operating per sequence of control.

1.7 SYSTEM START-UP AND ACCEPTANCE PROCEDURE
A. Upon completion of the calibration, the Control Contractor shall start up the system and perform all necessary testing and run diagnostic tests to ensure proper operation. Control Contractor shall be responsible for generating all software and entering all databases necessary to perform the sequence of control and specified software routines. An acceptance test in the presence of the Owner's representative or engineer shall be performed.

1.8 OWNER TRAINING

A. Provide sufficient but not less than 4 hours of training to the Owner's representatives, concerning the proper operation and maintenance of all control systems, sensing, monitoring and control equipment. Training sessions shall be conducted during normal business hours after system start-up and acceptance by the Owner.

B. Submit operating and maintenance manuals to Owner a minimum of five (5) working days prior to training session. Use these manuals as the basis for instruction at all training sessions.

C. Provide two follow-up visits for troubleshooting and instruction, one six months after substantial completion and the other at the end of the warranty period. Length of each visit to be not less than two (2) hours or the time necessary to provide required information and complete troubleshooting and inspection activity.

1.9 DELIVERY, STORAGE AND HANDLING

A. Factory shipping cartons for each piece of equipment. Factory-applied plastic end caps on each length of pipe and tube.

B. Maintain cartons and end caps through shipping, storage and handling as required to prevent equipment and pipe-end damage, and to eliminate dirt and moisture from equipment and inside of pipe and tube.

C. Where possible, store equipment and materials inside and protected from weather. When necessary to store outside, elevate well above grade and enclose with durable waterproof wrapping.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. Provide complete control systems consisting of thermostats, sensors, control valves, dampers, operators, indicating devices, interface equipment, and other apparatus required to operate mechanical system and to perform functions specified and in compliance with the sequence of operations described herein.

B. Provide necessary materials, labor and field work necessary to connect control components factory supplied as part of equipment controlled.

2.2 COORDINATION OF TEMPERATURE CONTROL WORK

A. Electric Wiring: All electric wiring in connection with the automatic temperature control system shall be furnished and installed by the Controls Trade, except for equipment starter interlocks, which are the responsibility of the Electrical Trade.

1. All 120 (line) volt or larger electrical service wiring and connections to equipment and motor starters is the responsibility of the Electrical Trade.

2. All additional line voltage power requirements beyond which is indicated on the Drawings and Specifications for the temperature control system shall be the responsibility of the Controls Trade.

B. Valves and Piping Wells: Furnish by Controls Trade, installed by HVAC Trade under supervision.

C. Dampers, Valves, Actuators and related Controlled Devices: Furnished by Controls Trade, installed by HVAC Trade under supervision.

2.3 CONTROL PANELS
A. Provide local panels of unitized cabinet type for each system under automatic control. Mount relays, switches, and controllers with control point adjustment in cabinet and temperature indicators, pressure gages, pilot lights, push buttons, and clocks and switches flush on cabinet panel face. All components within the control panels shall be prewired to numbered terminal strips, ready for field connection to field-mounted control components.

B. Control panels shall be constructed of steel or extruded aluminum with hinged door and keyed lock, with baked enamel finish of manufacturer’s standard color.

C. Mount panels adjacent to associated equipment on vibration free walls or free standing steel angle supports. One cabinet may accommodate more than system in same equipment room. Provide engraved plastic nameplates for instruments and controls inside cabinet and on cabinet face.

2.4 ELECTRICAL EQUIPMENT REQUIREMENTS

A. Provide electrical devices and relays that are UL listed and of a type meeting current and voltage characteristics of the project.

2.5 THERMOSTATS

A. Room Thermostats(Sensors):

1. Electronic Sensor Station: Single temperature sensor, modulating action, calibrated from 55-85 degrees F., two-piece construction with cover and sub-base with plug-in modular wiring harness.
2. Provide local adjustment with up/down pushbuttons and LCD readout of set point and space temperature at room thermostats(sensors).

B. Immersion Thermostats: For remote bulb elements use either averaging type or suitable length for air or rigid bulb type for liquids.

1. In liquids, use separable wells.
2. Duct thermostat sensing element shall be remote bulb or minimum 8 foot averaging element.
3. Thermostats shall be one or two-pipe, proportioning type, direct or reverse acting as required. Thermostat shall have adjustable set point and throttling ranges adequate for the application.

C. Outdoor Bulbs for Thermostats and Thermometers:

1. Locate on north side, with sun shield at least 10 feet above grade and at least 5 feet from openings.
2. Non-ferrous type securely fastened to construction.

2.6 FREEZESTATS (LOW-LIMIT CUT-OFF)

A. Freezestats shall be of the electric 2-position type with temperature sensing element and manual reset. Stats shall be capable of opening the stat circuit if any one-foot length of the sensing element is subject to a temperature below the stat setting.

B. Sensing element shall not be less than one lineal foot per square foot of coil surface area, minimum length 12 feet. Unless otherwise indicated, set freezestats at 38 deg. F.

2.7 SENSORS/TRANSMITTERS

A. Temperature Sensors (Room): Use a surface mount zone temperature sensor housed in a durable ventilated plastic wall-mount enclosure, with broad aluminum faceplate. The sensing element to be a 1,000 ohm RTD (nickel or silicon) 0-10 VDC, or 4-20 MA accuracy +/- 1/2% span.

B. Temperature Sensors (Discharge and Return Duct): Use a surface mount duct temperature sensor housed onto a standard metal handibox. The sensing element to be a 10,000-ohm RTD (nickel or silicon) 0-10 VDC, or 4-20 MA. House sensor in an 8-1/2” stainless steel probe. Accuracy +/- 1/2% span.
C. **Temperature Sensor (Mixed Air - Averaging):** Select an averaging capillary type sensor housed on a standard metal handi box. The capillary type sensor to house no less than five sensing elements, which will return an average of the five or more sensor elements. The sensing elements are to be a 1,000-ohm RTD (nickel or silicon) 0-10 VDC, or 4-20 MA. Accuracy +/- 1/2% span.

D. **Immersion type temperature sensors:** Rod and tube type with linear output. Provide separable thermo wells with heat conductive fluid for installation in pipeline. Units shall be factory calibrated.

E. **Ambient Static Pressure Sensor (reference):** Equal to BAPI model ZPS-ACC-10 outside air pickup port or approved equal.

F. **Carbon Monoxide (CO) Sensor:** Pro vide a Carbon Monoxide (CO) sensor that shall utilize electro-mechanical technology. The sensor shall have a linear analog output over a range of 0-200 ppm and have built-in display of CO level. The sensor shall have an automatic calibration algorithm that will compensate for sensor drift over time due to sensor element degradation.

   1. Unit shall be provided with a 0-10VDC or 4-20mA analog output that is selectable and a field adjustable relay alarm output.
   2. Accuracy shall be better than ±3% of full scale.
   3. The sensor shall be user calibratable with a minimum calibration interval of five years.

2.8 **CONTROL VALVES**

A. **Water Valves:**

   1. Furnish all modulating straight-through water valves with equal-percentage contoured throttling plugs. Furnish all three-way valves with linear throttling plugs such that the total flow through the valve shall remain constant regardless of the valve's position.
   2. Size 3-way control valves for a pressure drop equal to the unit they serve but not to exceed 5 psi.

B. Valves 2" and smaller shall be screwed type, forged or cast brass, 125 PSIG rated, stainless steel stems, synthetic elastomeric or teflon packing.

C. 2-1/2" and larger valves shall be iron body, bronze mounted, stainless steel stems, PTFE teflon packing.

2.9 **ELECTRIC CONTROL ACTUATORS**

A. Electronic Actuators shall be sized to operate their appropriate dampers or valves with sufficient reserve power to provide smooth proportional action or two-position action as specified.

   1. **Modulating Valves:** Valve actuators shall accept proportional 0-10 VDC or 0-20 mA signals for modulating action.
   2. **Two-Position Valves:** May be provided at radiation valves or convectors.
   3. **Three-way Valves:** Air handling unit water coils.

B. Provide positive position sequencing relays for accuracy and non-overlapping operation of two or more actuators where required system design function.

C. Actuators shall be designed to allow replacement of seal glands without draining the piping system.

D. **Acceptable Manufacturers:** Belimo or approved equal.

2.10 **NORMAL POSITIONS**

A. Regardless of type of system, each device shall assume specified normal positions on power failure.

B. Normal positions shall be safe positions and as follows:

   1. Outside and Relief/Exhaust Air Dampers: Normally closed.
   2. Return Air Damper: Normally open.
3. Automatic Control Valves: Normally open - full flow thru heat transfer device.
4. Terminal Heating Valves: Normally open valve position; spring-return to full flow thru heat transfer device.

2.11 CONTROL DAMPERS

A. The control trade shall furnish all control dampers as shown on the plans and/or as required to perform the control sequence specified except those furnished with fan equipment.

B. All modulating dampers shall be sized by the control trade to meet flow requirements of the application in accordance with his recommendation. All two-position dampers to be sized as close as possible to duct size, but in no case is damper size to be less than 90% of duct area.

C. Unless otherwise indicated, all control dampers shall be opposed blade type. Two position dampers may be parallel blade type.

D. All dampers shall be factory fabricated and shall be standard products of the control manufacturer.

E. Damper frames shall not be less than 13 gauge galvanized steel or extruded aluminum of 12 gauge. Blades shall not be less than 16 gauge galvanized steel or 14 gauge aluminum, not over 8 inch width with steel trunnions mounted in a bronze sleeve or ball bearings.

F. All blade linkage hardware shall have corrosion-resistant finish and be readily accessible for maintenance.

G. Fresh and Relief Air Dampers: Furnish low-leakage type dampers with replaceable neoprene edging seals installed at all four sides of the frame and each blade.

1. Dampers and seals shall be suitable for maximum temperature and air velocities to be encountered in the system with the minimum temperature ranges of -40 degrees F to 200 degrees F.
2. Submit leakage and flow characteristic data for all control dampers along with shop drawings.
3. Dampers when closed, shall be guaranteed by the control manufacturer not to leak air in excess of 1/2% at 4 inches static pressure water gauge.

PART 3 - EXECUTION

3.1 GENERAL

A. Install all control equipment, wiring and air piping in a neat and workmanlike manner.

B. All immersion wells, pressure tappings and any associated shut-off valves, flow switches, level switches and other such items furnished by the control manufacturer shall be installed by the mechanical contractor under the coordinating control and supervision of the control contractor.

C. Install all control devices in an accessible location.

D. Electrical Wiring: All electrical wiring for the automatic control system, excluding line voltage power to control panels, as indicated on the Drawings, shall be furnished and installed by the Temperature Control Contractor in accordance with this specification section. All the electrical sections of this specification and all applicable electric codes shall apply to the required work.

1. Sensor and/or control wiring shall be provided with conduit independent of those used for high voltage, switches AC or other signals which may create interference or cause induced voltages which promote signal drift or reduced accuracy. Sensor and high voltage wiring may not be run in the same conduit.

3.2 INSTALLATION

A. Check and verify location of thermostats, room sensors and other exposed control sensors with plans and piping details before installation. Locate thermostats and sensors 60 inches above floor.
1. Isolated from exterior walls as recommended by manufacturer.
2. Located where not exposed to direct rays of sun, and where not influenced by concealed or adjacent heating, domestic hot water piping or warm air currents.

B. Valve tops, inserts or bonnets, sensors, thermostats, thermometers, gauges, and damper motors of all types:
1. Provide with access doors and/or access panels, in building construction so that they may be readily removed, replaced and serviced.
2. Access doors and access panels by HVAC Contractor.

C. Control Wiring of all Kinds:
1. All control wiring to be labeled at both ends identifying termination and origination point.
2. In conduit and included with temperature control system.
3. Concealed low voltage control wiring may be routed as cabling.
4. Exposed control wiring shall be in EMT conduit in mechanical areas or prefinished surface raceways in occupied areas. Submit surface raceway systems for prior approval before installation.
5. Conforming to all requirements of Electrical Specifications, Division 16.

D. Locate controls, relays, instruments, switches, valves, devices and accessories so they are readily accessible for adjustment, service, and replacement or as indicated on the drawings.

E. Install control valves horizontal with power unit up unless otherwise indicated. Maximum variation from vertical is 45 degrees.

F. Locate, size and support temperature sensing elements in water streams to properly sense the representative temperature.
1. For controlling, transmitting and indicating elements, sensing device located, sized and of the type to sense the average condition.
2. Wells shall not obstruct the flow of the fluid being measure.
3. Pipes 1" and smaller shall be increased at least one pipe size at point of insertion.

G. Where insulation on piping, ductwork or equipment is punctured or penetrated due to the installation of sensing elements or tubing, reseal the openings air and vapor tight.

H. Where control devices are to be located on insulated surfaces, provide brackets to clear the finished surface of the insulation avoiding punctures of the vapor seal.

I. Locate support, enclose and install control devices and equipment so that they will not be subject to:
1. Vibration
2. Excessive temperatures
3. Dirt, moisture or other harmful effects.
4. Conditions beyond their rated limitations.

J. Conceal all piping except piping in mechanical rooms and other areas where mechanical system piping may be exposed.

K. Install all exposed piping and conduit parallel to or at right angles to the building structure and support adequately at uniform intervals. Use only tool made bends.

L. Make tests on piping from time to time during the progress of installation to insure against leaks.

3.3 TESTING, ADJUSTING AND PERFORMANCE DEMONSTRATIONS

A. All controlling devices which are a part of the automatic temperature control system, shall be tested and adjusted by the Contractor before system is offered for final acceptance.
1. All associated devices, valves, operators and dampers adjusted.
2. All operating and positioning of all dampers verified.

B. After all calibrations, adjustment and checking have been completed and all systems are operational:

1. Demonstrate to User's representative, the complete and correct functioning of all control systems and equipment.
2. Demonstrations shall consist of operating the controls through their normal full ranges and sequences.
3. Simulate abnormal conditions to demonstrate proper functioning of safety devices.
4. Readjust all settings to their correct design values and after sufficient time, observe ability of controls to establish the desired conditions, noting any abnormal deviations.
5. Make any necessary repairs, replacements or adjustments on all items which fail to perform satisfactorily, all to the satisfaction of the Owner's representative.

C. Upon completion of the work and testing, but prior to final acceptance:

1. A representative of the control system manufacturer shall spend at least 4 hours or such length of time as necessary to instruct the Owner's personnel in proper operation, adjustment and maintenance of the control equipment and systems.
2. Instruction shall be performed by competent, trained, full-time employees of the control system manufacturer who have a complete working knowledge of the systems and equipment installed in this job.
3. Provide 4 hours follow-up visit within 3 months after completion to trouble-shoot and answer questions regarding the control system.

END OF SECTION
PART 1 - GENERAL

1.1 SCOPE

A. The DDC control work associated with this section are part of the Temperature Control scope of the Work.

B. The Building Automation System (BAS) shall be capable of integrating multiple building functions, including equipment supervision and control, alarm management, energy management, and trend data collection.

C. The Building Automation System (BAS) shall be an a hardwired network with a server on the Owner’s network LAN rack. All Building Management Functions shall be operable from a Web-based workstation.

D. The BAS shall consist of the following:
   1. Interface with the Building Operator's Station.
   2. Direct Digital Control Panels.
   3. Standalone Application Specific Controllers (ACSs).
   4. BACnet Network Wiring.
   5. LAN/WAN Integration.

E. Industry standard Open Communication Protocols shall be provided as specified in the applicable communication sections.

F. BACnet compliance:
   1. The Building Management System (BMS) shall be operable on a BACnet bus.
   2. General Purpose Controllers, Unitary Controllers, Dedicated Equipment Controllers and PC-based workstations shall be able to operate and communicate on the 2-wire BACnet bus without the need of using gateways or drivers.
   2. The Systems Integrator shall after all hardware (devices/nodes and wiring) has been installed provide all necessary device installation, device configuration, device diagnostics, network variable binding and systems diagnostics.

G. The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, ASCs, and operator devices.

H. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

1.2 RELATED WORK

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified elsewhere:
   1. 23 90 00 Controls and Instrumentation
   2. 23 95 00 Control Sequences
   3. 23 95 10 DDC Point List
   4. Division 26 Electrical Sections

1.3 QUALITY ASSURANCE
A. Installer Qualifications: A firm specializing and experienced in DDC control system installation with a local service office within 30 miles of Madison, WI and experience with similar installations for no less than five (5) years. All work to be done by qualified mechanics in the direct employ of this manufacturer.

B. Electrical Standards: Provide electrical products, which have been tested, listed and labeled by Underwriters' Laboratories (UL) and comply with NEMA standards.

C. DDC Standards: DDC manufacturer shall provide written proof with shop drawings that the equipment being provided is in compliance with F.C.C. rules governing the control of interference caused by Digital Electronic Equipment to Radio Communications (1979 Amendment to Part 15, Subpart J).

1.4 SUBMITTALS

A. Product Data:

1. Submit manufacturer's specifications for each control device furnished, including installation instructions and startup instructions. General catalog sheets showing a series of the same device is not acceptable unless the specific model is clearly marked.

2. Annotated software program documentation shall be submitted for system sequenced, along with descriptive narratives of the sequence of operation of the entire system involved.

3. Submit point-point wiring diagrams for each electrical control device with other details required to demonstrate that the system has been coordinated and will function as a systems.

B. Maintenance Data: Submit maintenance data and spare parts lists for each control device. Include this data in maintenance manual.

C. Record Drawings: Prior to request for final payment, provide complete composite record drawings to incorporate the DDC and Pneumatic/Electric fieldwork.

1.5 MATERIAL DELIVERY AND STORAGE

A. Provide factory shipping cartons for each piece of equipment and control device. This contractor is responsible for storage of equipment and materials inside and protected from the weather.

PART 2 - PRODUCTS

2.1 NETWORKING/COMMUNICATIONS

A. The design of the BAS shall be networked as shown on the attached system configuration drawing. Inherent in the system's design shall be the ability to expand or modify the network either via a local network, auto-dial telephone line modem connections, or a combination of the two networking schemes.

B. Building Operator's Station: Provided by Owner.

C. Local Network:

1. Building Operator's Station /Panel Support: The Building Operator's Station or Digital Panel shall directly oversee a local network such that communications may be executed directly to and between ASCs. The Operator's Terminal version or Digital Panel version shall be referred to as the "Digital Panel(s)" throughout this document.

2. Data Access: All operator devices either network resident or connected via dial-up modems, shall have the ability to access all point status and application data on the network. Access to system data shall not be restricted by the hardware configuration of the facility management system.
3. **Global Data Sharing:** Global Data Sharing or Global point broadcasting shall allow point data to be shared between ASCs, when it would be inefficient or impractical to locate multiple sensors.

4. **General Network Design:** Network design shall include the following provisions:
   a. Data transfer rates for alarm reporting and quick point status from multiple ASCs.
   b. Support of any combination of ASCs. A minimum of 100 ASCs shall be supported on a single local network. The bus shall be addressable for up to 255 ASCs.
   c. Detection of single or multiple failures of the ASCs or the network media.
   d. Error detection, correction, and retransmission to guarantee data integrity.
   e. Commonly available, multiple sourced, networking components shall be used.
   f. Use of an industry standard protocol, such as Optomux, and IEEE RS-485 communications interface.

D. The HVAC BAS provided under this section of the specifications shall consist of a distributed Client-Server, Local Area Network (LAN) based system, incorporating PC based Operator Workstations with dynamic multicolored graphic displays, a PC-based Server, a dedicated local area network, routers, switchers, network nodes, direct digital control system and software to provide interoperability with the server software. The system is to be furnished and installed in its entirety by this supplier.

E. The HVAC BAS shall be modular in design and scaleable in implementation from an initial installation of a single server with minimum of two concurrent operator workstations to a system with up to 40 concurrent operator workstations, unlimited web browser access (using Internet Explorer 6.0) to system information for monitoring and control functions, and field controller network interfaces to permit expansion to 60,000 physical hardware points.

### 2.2 DIGITAL PANELS

A. **General:** Digital Panels shall be microprocessor-based, multi-tasking, multi-user, digital control processors.

B. **Memory:** Each Digital Panel shall have sufficient memory to support its own operating system and databases including:
   1. Control Processes
   2. Energy Management Applications
   3. Alarm Management
   4. Trend Data
   5. Maintenance Support Applications
   6. Operator I/O
   7. Dial-Up Communications
   8. Manual Override Monitoring

C. **Expandability:** The system shall be modular in nature, and shall permit easy expansion through the addition of field controllers, sensors, and actuators.

D. **Serial Communication Ports:** Digital Panels shall provide at least two RS-232C serial data communication ports for simultaneous operation of multiple operator I/O devices such as laptop computers, Personal Computers, and Video Display terminals.

E. **Hardware Override Monitoring:** Digital Panels shall monitor the status of all overrides, and include this information in logs and summaries to inform the operator that automatic control has been inhibited.

F. **Integrated On-Line Diagnostics:** Each Digital Panel shall continuously perform self-diagnostics, communication diagnosis and diagnosis of all subsidiary equipment. The Digital Panels shall provide both local and remote annunciation of any detected component failures, or repeated failure to establish communication. Indication of the diagnostic results shall be provided at each Digital Panel.

G. **Surge and Transient Protection:** Isolation shall be provided at all network terminations, as well as all field point terminations to suppress induced voltage transients consistent with IEEE Standard 587-1980. Isolation levels shall be sufficiently high as to allow all signal wiring to be run in the same conduit as high voltage wiring where acceptable by electrical code.

H. **Power fail Restart:** In the event of the loss of normal power, there shall be an orderly shutdown of the Digital Panels to prevent the loss of database or operating system software. Non-volatile memory shall be incorporated for all critical
controller configuration data, and battery back up shall be provided to support the real-time clock and all volatile memory for a minimum of 72 hours.

1. Upon restoration of normal power, the Digital Panels shall automatically resume full operation without manual intervention.

2.3 SYSTEM SOFTWARE FEATURES

A. General

1. All necessary software to form a complete operating system as described in this specification shall be provided.
2. The software programs specified in this section shall be provided as an integral part of the Digital Panel and shall not be dependent upon any higher-level computer for execution.

B. Graphic Requirements: Provide color graphic backgrounds with operational information interface for the following systems:

1. Rooftop Unit RT-1, Relief Fan RF-1 and related.
4. Make-up Air Unit MAU-1, Exhaust Fan EF-1 and Garage Ventilation Controls.
5. Radiant Heater RH-1.

C. Control Software Description:

1. Equipment Cycling Protection: Control software shall include a provision for limiting the number of times each piece of equipment may be cycled within any one-hour period.
2. Heavy Equipment Delays: The system shall provide protection against excessive demand situations during start-up periods by automatically introducing time delays between successive start commands to heavy electrical loads.
3. Powerfail Motor Restart: Upon the resumption of normal power, the DDC panel shall analyze the status of all controlled equipment, compare it with normal occupancy scheduling, and turn equipment on or off as necessary to resume normal operation.

D. Energy Management Applications: Digital Panels shall have the ability to perform any or all of the following energy management routines:

1. Time of Day Scheduling
2. Calendar Based Scheduling
3. Holiday Scheduling
4. Temporary Schedule Overrides
5. Optimal Start
6. Optimal Stop
7. Demand Limiting
8. Load Rolling
9. Heating/Cooling Interlock
10. Average/High/Low Signal Select and Reset

All programs shall be executed automatically without the need for operator intervention, and shall be flexible enough to allow user customization. Programs shall be applied to building equipment as described in the “Execution” portion of this specification.

E. Programming Capability: Digital Panels shall be able to execute configured processes defined by the user, to automatically perform calculations and control routines.

1. Process Inputs and Variables: It shall be possible to use any of the following in a custom process:
   a. Any system-measured point data or status
   b. Any calculated data
   c. Any results from other processes
d. Boolean logic operators (and, or,)

2. Process Triggers: Configured processes may be triggered based on any combination of the following:
   a. Time of Day
   b. Calendar Date
   c. Other Processes
   d. Events (e.g., point alarms)

3. Data Access: A single process shall be able to incorporate measured or calculated data from any and all other ASCs.

F. Alarm Management: Alarm management shall be provided to monitor, buffer, and direct alarm reports to operator devices and memory files. Each Digital Panel shall perform distributed, independent alarm analysis and filtering to minimize operator interruptions due to non-critical alarms, minimize network traffic, and prevent alarms from being lost. At no time shall the Digital Panel's ability to report alarms be affected by either operator activity at the local I/O device, or communications with other ASCs on the network.

   1. Alarm Messages: In addition to the point's descriptor and the time and date, the user shall be able to print, display or store a 60-character alarm message to more fully describe the alarm condition or direct operator response.
   2. Each Digital Panel shall be capable of storing a library of at least 100 Alarm Messages. Each message may be assignable to any number of points in the panel.
   3. Auto-Dial Alarm Management: In dial-up applications, only critical alarms shall initiate a call to a remote operator device. In all other cases, call activity shall be minimized by time-stamping and saving reports until an operator scheduled time, a manual request, or until the buffer space is full. The alarm buffer must store a minimum of 50 alarms.

G. Trend Analysis: A data collection utility shall be provided to automatically sample, store and display system data. Measured and calculated analog and binary data shall be assignable to user-definable trends for the purpose of collecting operator-specified performance data over extended periods of time. Sample intervals of 1 minute to 24 hours, in one-minute or one-hour intervals, shall be provided. Each Digital Panel shall have a dedicated buffer for trend data, and shall be capable of storing 32 trend logs. Each trend log shall have up to 4 points trended at 168 data samples each. Data shall be stored at the Digital Panel.

H. Runtime Totalization: Digital Panels shall automatically accumulate and store runtime hours for binary input and output points as specified in the “Execution” portion of this specification.

   1. The Totalization routine shall have a sampling resolution of one minute.
   2. The user shall have the ability to define a warning limit for Runtime Totalization. Unique, user-specified messages shall be generated when the limit is reached.

I. Event Totalization: Digital Panels shall have the ability to count events such as the number of times a pump or fan system is cycled on and off. Event totalization shall be performed on a daily, weekly, or monthly basis.

   1. The Event Totalization feature shall be able to store the records associated with a minimum of 9,999,999 events before reset.
   2. The user shall have the ability to define a warning limit. Unique, user-specified messages shall be generated when the limit is reached.

2.4 APPLICATION SPECIFIC CONTROLLERS - HVAC APPLICATIONS

A. Each Digital Panel shall be able to extend its performance and capacity through the use of standalone Application Specific Controllers (ASCs).

B. Each ASC shall operate as a standalone controller capable of performing its specific control responsibilities independently of other controllers in the network. Each ASC shall be of microprocessor-based, multi-tasking, real-time digital control processor.

C. Each ASC shall have sufficient memory to support its own operating system and databases including:

   1. Control Processes
2. Energy Management Applications
3. Operator I/O (Portable Service Terminal)

D. The operator interface to any ASC point data or programs shall be through the Digital Panel or portable operator's terminal connected to any ASC on the network.

E. ASCs shall directly support the temporary use of a portable service terminal that can be connected to the ASC via zone temperature or directly at the controller. The capabilities of the portable service terminal shall include, but not be limited to, the following:

1. Display temperatures
2. Display status
3. Display set points
4. Display control parameters
5. Override binary output control
6. Override analog set points
7. Modification of gain and offset constants

F. Powerfail Protection: All system setpoints, proportional bands, control algorithms, and any other programmable parameters shall be stored such that a power failure of any duration does not necessitate reprogramming the ASC.

1. Unitary Controllers:
   a. Unitary Controllers shall support, but not be limited to, the following types of systems to address specific applications described in the “Execution” portion of this specification, and for future expansion:
      1.) Unit Vents (ASHRAE Cycle I., II, III, or W)
      2.) Heat Pumps (Air-to-Air, Water-to-Air)
      3.) Packaged Rooftops
      4.) Fan Coils (Two-Pipe, Four-Pipe)
   b. Unitary Controllers shall support the following types of point inputs and outputs:
      1.) **Economizer Switchover Inputs**
         a.) Drybulb
         b.) Outdoor Air Enthalpy
         c.) Differential Temperature
         d.) Binary Input from a separate controller
      2.) **Economizer Outputs**
         a.) Integrated Analog with minimum position
         b.) Binary Output to enable self-contained
         c.) Economizer Actuator
      3.) **Heating and Cooling Outputs**
         a.) 1 to 4 Stages
         b.) Analog Output with two-pipe logic
         c.) Reversing valve logic for Heat Pumps
      4.) **Fan Output**
         a.) On/Off Logic Control
   c. Unitary controllers shall support the following library of control strategies to address the requirements of the sequences described in the “Execution” portion of this specification, and for future expansion:
      1.) Daily Schedules
      2.) Comfort/Occupancy Mode
      3.) Economy Mode
         a.) Standby Mode/Economizer Available
         b.) Unoccupied/Economizer Not Available
         c.) Shutdown
      4.) Lighting Logic Interlock to Economy Mode
      5.) Temporary Override Mode
         a.) Temporary Comfort Mode (Occupancy-Based Control)
         b.) Boost (Occupant Warmer/Cooler Control)
   d. **Alarm Management:** Each VAV Terminal Unit Controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.
2. **AHU Controllers**
   a. AHU Controllers shall support, but not be limited to the following configurations of systems to address current requirements as described in the “Execution” portion of this specification, and for future expansion:
      1. Air Handling Units
         - Mixed Air-Single Path
         - Mixed Air-Dual Path
         - 100% Single Path
         - 100% Dual Path
   b. AHU Controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally standalone fashion.
   c. AHU controllers shall have a library of control routines and program logic to perform the sequence of operation as specified in the “Execution” portion of this specification.
   d. Continuous Zone Temperature Histones: Each AHU Controller shall automatically and continuously, maintain a history of the associated zone temperature to allow users to quickly analyze space comfort and equipment performance for the past 24 hours. A minimum of two samples per hour shall be stored.
   e. Alarm Management: Each AHU Controller shall perform its own limit and status monitoring and analysis to maximize network performance by reducing unnecessary communications.
   f. Each AHU Controller shall come with a hand-held Zone Terminal permanently mounted at the controller to allow interface with the controller. This device will allow the user to monitor or adjust set points and time scheduling within a specific zone.

3. **Lab and Central Plan (LCP) Controllers:**
   a. LCP controllers shall support, but not be limited to, the following configurations of systems to address current requirements described in the “Execution” portion of this specification, and for future expansion.
      1. Single boiler or chiller plants with pump logic
      2. Cooling towers
      3. Zone pressurization of labs
      4. Air Handling Units and Roof-top units with complex controls sequences
      5. Plant Heating and Cooling circuits
      6. Heat exchangers
   b. LCP controllers shall support all the necessary point inputs and outputs to perform the specified control sequences in a totally standalone fashion. A minimum of 30 I/O points expandable to 94 shall be supported by the LCP.

2.5 **OPERATOR INTERFACE**

A. **Basic Interface Description:**

1. **Command Entry/Menu Selection Process:** Operator interface software shall minimize operator training through the use of English language prompting, English language point identification.
   a. The operator interface shall have the option of using a mouse or similar pointing device for a “point and click” approach to facilities management. Users shall be able to start and stop equipment or change set points from graphical displays through the use of a mouse or similar pointing device.

2. **Password Protection:** Multiple-level password access protection shall be provided to allow the user/manager to limit control, display and database manipulation capabilities as he deems appropriate for each user, based upon an assigned password.
   a. Passwords shall be exactly the same for all operator devices.
   b. A minimum of four (4) levels of access shall be supported:
   c. A minimum of eight (8) passwords shall be supported at each Digital Panel.
   d. Operators will be able to perform only those commands available for their respective passwords. Menu selections displayed at any operator device, shall be limited to only those items defined for the access level of the password used to log-on.
   e. User-definable, automatic log-off timers of from 1 to 60 minutes shall be provided to prevent operators from inadvertently leaving devices logged on.
4. **Operator Commands:** The operator interface shall allow the operator to perform commands including, but not limited to, the following:
   a. Start-up or shutdown selected equipment
   b. Adjust set points
   c. Add/Modify/Delete time programming
   d. Enable/Disable process execution
   e. Lock/Unlock alarm reporting for each point
   f. Enable/Disable Totalization for each point
   g. Enable/Disable Trending

**PART 3 - EXECUTION**

3.1 **INSTALLATION**

A. Install the control system in accordance with manufacturer's instructions.

3.2 **DEMONSTRATION**

A. The system manufacturer or his representative shall provide start-up and adjustment service for the control system.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION
A. Section 23 90 00 - Controls and Instrumentation, applies to the work of this section.

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 shall govern work under this section.
B. Refer to schematic layout of control and HVAC equipment on HVAC drawings.
C. Specified Elsewhere:
   1. 23 9000 Controls and Instrumentation
   2. 23 9100 Direct Digital Control Systems
   3. 23 9510 DDC Point List

PART 2 - PRODUCTS

2.1 MATERIALS
A. Refer to Section 23 9000 - Controls and Instrumentation.

PART 3 - EXECUTION

3.1 CONTROL SEQUENCE
A. Systems shall perform in accordance with the following descriptions of the control strategy intent.
B. BAS = Building Automation System (DDC Controls).

3.2 OCCUPIED/UNOCCUPIED CONTROL
A. Building Automation System (BAS) controls shall schedule occupied/unoccupied schedules for HVAC equipment.
B. Provide occupied/unoccupied schedules for the following HVAC Equipment.
   1. Rooftop Unit RT-1.

3.3 HOT WATER SECONDARY CIRCULATION PUMP P-1
A. Pump shall be started by the BAS (Building Automation System) and shall operate continuously during the heating season. Pump shall be monitored for failure, as sensed by current switches.
C. Pump Capacity Control: Integral pump static pressure controller shall modulate pump capacity through signal to ECM motor speed controls to maintain constant setpoint pressure differential as scheduled.

3.4 BOILER CIRCULATION PUMP P-2
A. Interlock boiler pump shall be interlocked with the respective boiler control to operate with the boiler. Pump shall be monitored for failure, as sensed by current switches.

3.5 HOT WATER HEATING SYSTEM

A. Boiler manufacturer shall provide a microprocessor controller at each boiler and networked together to provide a tandem operating system as part of the integral boiler management system (BMS) at the master boiler control panel. The master boiler control panel shall be BACnet protocol compatible and provide a DDC control network connection.

B. Hot water supply to the system shall be reset by outside air temperature with one sensor in the hot water supply to maintain a building hot water supply temperature and one sensor outside measuring ambient conditions as dictated by the following reset schedule:

<table>
<thead>
<tr>
<th>Outdoor Air Temperature</th>
<th>Hot Water Supply Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>-15 degrees F</td>
<td>160 degrees F</td>
</tr>
<tr>
<td>60 degrees F</td>
<td>100 degrees F</td>
</tr>
</tbody>
</table>

C. One(1) modular boilers shall be staged and modulated into operation to maintain a hot water supply temperature in the hot water buffer tank and HWS header as scheduled.

D. HWS high limit alarm set at 200 degree F.

E. The BAS controls shall be provided by the Temperature Control Contractor (TCC), the BACnet protocol controller at each boiler shall be provided by the boiler equipment supplier as part of the boiler equipment package. The boiler control system shall enable and disable boiler, control each boiler capacity, optimize boiler plant efficiency, monitor and control hot water supply and return temperatures. The BAS controls shall access BACnet boiler system points and monitor boiler status through each boiler control communication interface (BACnet network).

F. Temperature Control Contractor shall be responsible for mounting all Boiler Control Panel sensors and interfacing with the boiler representative upon boiler startup and control panel setup.

3.6 ROOFTOP UNITS RT-1/RF-1

A. System consists of a draw-through single path air handling unit with variable volume supply and exhaust-relief fans, mixing box/relief control dampers, DX cooling coil, lead digital-scroll compressor, and modulating gas-fired bonnet.

1. Factory mounted sensors and wiring to VAV controller.
2. Furnish filter pressure drop monitoring signal.
3. Return duct smoke detectors factory installed in the return air ductwork.
4. VFD for supply fan and relief fan shall be factory installed and wired.

B. Dampers and Damper actuators operators factory-mounted for mixed air and relief dampers mounted in factory rooftop air handling unit.

C. Occupied Mode: Supply fan SF shall run continuously with mixed air dampers at minimum fresh air position (0%) and relief air dampers closed. Discharge air controller shall sequence dry bulb economizer low-limit control, modulate lead digital scroll compressor serving cooling coil and sequence gas-fired heating bonnet to maintain discharge air temperature setpoint. Discharge air temperature setpoint shall be reset by the most demanding VAV box on a call for cooling.

1. Discharge Air Reset Range: 54 to 65 degrees F.
2. Minimum fresh air - 700 CFM provided directly to return air ductwork.

D. Unoccupied Mode: Supply fan SF shall shutdown, relief air dampers closed and mixing box air dampers move to 100% return air position.

1. Fan and cooling compressor and gas-fired heating stages shall cycle in unoccupied mode to satisfy unoccupied mode space setpoint temperature at space sensors.
E. **Morning Warm-Up/Cool-Down Mode:** On morning warm-up/cool-down mode, supply fan shall operate continuously with 100% return air. Mechanical cooling or gas-fired bonnet at unit shall operate to satisfy designated setpoint. During heating mode, reheat coil valves shall open 100% to supply heat to discharge air until return air temperatures reach a preset warm-up set point temperature.

1. **Initial Warm-Up/Cool-Down Set Point:** 70/74 degrees F.

F. **VAV Supply Air Fan SF Capacity Control:** Static pressure controller with duct-mounted pressure sensor where shown on the Drawings shall modulate supply air fan volume through VFD motor speed controls to maintain minimum duct static setpoint in supply duct at sensor locations.

1. **Initial Setpoint:** 0.70" W.G. (adjustable)
2. High limit supply duct static pressure control set at 3.0" W.G. shall shut down supply and return fans and signal alarm with manual reset.

G. **Economizer Control:** A low-limit mixed air dry bulb controller will sense return air and outside air dry bulb conditions and modulate mixing box dampers in sequence from minimum position to maintain optimum mixture for satisfying the discharge air setpoint conditions during cooling.

H. **Building Space Pressurization Control:** Space static pressure controller shall modulate exhaust air fan (RF-1) volume through VFD motor speed controls to limit space static pressure setpoint differential from ambient reference static pressure during economizer operation.

1. **Space Static Reset Range:** positive (+) 0.08" W.G. (adjustable).

I. **Carbon Dioxide Monitoring:** A carbon dioxide sensor in the return air duct shall be used for monitoring and alarm purposes.

J. **Building Humidity Monitoring:** Humidity sensor in the return air duct shall be used for monitoring and alarm purposes only.

3.7 **VAV TERMINAL UNITS WITH REHEAT**

A. The VAV terminal units shall be individually controlled by a DDC VAV controller per VAV terminal unit. VAV box manufacturer shall provide flow ring with VAV box. The DDC controller, damper motor, and differential pressure transducer shall be supplied by the BAS Contractor and furnished to the terminal unit supplier for factory installation.

B. The room sensor working through the pressure independent DDC controller shall modulate the box damper from minimum damper position and reheat coil valve to maintain discharge air setpoint at 70 deg F heating and 75 deg F cooling. Discharge air shall be reset by the space stat to satisfy the space conditions.

1. **Reset range 55 deg F - 100 deg F.**

C. **Unoccupied:** The reheat coil valve shall move to its 100% open position.

D. **Morning Warm-Up:** The box damper and reheat coil valve shall remain in 100% open position.

3.8 **UNIT HEATER UH-1**

A. Fan shall cycle to satisfy space sensor setpoint for heating.

3.9 **GAS-FIRED MAKE-UP AIR UNIT MAU-1/EXHAUST FANS EF-1 & EF-2**

A. System consists of a draw-through single path air handling unit with constant volume supply fan, filter bank, inlet motorized fresh air dampers and modulating gas-fired bonnet.

B. The factory supplied MAU controller shall provide electronic signal to MAU gas train controls to control discharge air temperature at MAU.
1. Enable MAU-1 and monitor fan status.
3. Furnish filter pressure drop monitoring and alarm signal.

C. Inlet motorized dampers and operator are line voltage and provided by the equipment supplier and wired by the Electrical Contractor.

D. **Ventilation Mode:** MAU-1 supply fan and exhaust fans EF-1 or EF-2 shall run continuously. Motorized fresh dampers shall opens 100%. MAU-1 discharge air controller shall modulate direct gas-fired bonnet capacity to maintain discharge air temperature setpoint (heating only). Discharge air temperature setpoint shall be set remotely at MAU local control panel.

   1. EF-1 and EF-2 fans shall not operate simultaneously;
   2. Motorized louvers at cupola will be locked closed during EF-1 & 2 operation; operational for gravity ventilation only.

E. **Garage Ventilation Control:**

   1. Upon detection of Carbon Monoxide (CO) levels of 35.0 PPM at wall sensors shall start ‘Ventilation Mode’. Continue to operate in ‘Ventilation Mode’ for a minimum period of 15 minutes (adj.) or until CO levels drop below 25 PPM.
   2. Upon detection of Nitrous Dioxide (NO₂) levels of 1.0 PPM at ceiling sensors shall start ‘Ventilation Mode’ with EF-2 fan in operation. Continue to operate in ‘Ventilation Mode’ for a minimum period of 15 minutes (adj.) or until NO₂ levels drop below 0.7 PPM.
   3. Schedule minimum of 5 hours per day of ‘Ventilation Mode’ operation as determined by the Owner per programmable time clock.
   4. Provide at local control panel: H-O-A switch for EF-2 fans, H-O-A switch for EF-1 fans and Open-Close switch for gravity ventilation at motorized cupola louvers (Summer).

F. **Storage Ventilation Control:**

   1. Provide at local control panel: H-O-A switch for EF-2 fan and Open-Close switch for gravity ventilation at motorized cupola louvers (Summer).
   2. Interlock fresh inlet air dampers to open with EF-2 operation and gravity ventilation.

3.10 **GAS-FIRED RADIANT HEATERS**

A. Cycle fan and burner stages upon a call for heating from space sensor.

   1. Two-stage burners.

**END OF SECTION**
SECTION 23 95 10
DDC POINT LIST

PART 1 - GENERAL

1.1 DESCRIPTION
A. Direct Digital Control (DDC) Point List.

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 shall govern work under this section.
B. Refer to schematic layout of control and HVAC equipment on HVAC drawings.
C. Specified Elsewhere:
   1. 23 90 00 Controls and Instrumentation
   2. 23 91 00 Direct Digital Control Systems
   3. 23 95 00 Control Sequences

PART 2 - PRODUCTS

2.1 MATERIALS
A. Refer to Section 23 90 00 - Controls and Instrumentation.
B. Refer to Section 23 91 00 - Direct Digital Control Systems.

PART 3 - EXECUTION

3.1 DDC POINT LIST
A. Controls systems shall provide the DDC input/output control points and related as scheduled on the attached sheets 23 95 10 - 2 and 3.

END OF SECTION
<table>
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<tr>
<th>POINT</th>
<th>DESCRIPTION</th>
<th>TYPE</th>
<th>OPERATION</th>
<th>SCHEDULE</th>
<th>ALARM</th>
<th>HISTORY</th>
<th>FIELD DEVICE</th>
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<td>TEMP SPACE SENSOR</td>
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END OF SECTION
SECTION 23 9600
STARTING OF MECHANICAL SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Contractor:
   1. Provide material and labor required for start up of all equipment and systems installed under general contract.
   2. Coordinate start-up work with pipe cleaning, pipe system leak tests, and initial system fill and venting.
   3. Provide all information and assistance required for cooperation with testing, adjusting and balancing services.
   4. Contractor shall coordinate start-up of mechanical equipment with manufacturer's representative to be present for supervision and certification of correct operating procedures.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:
   1. 23 05 90 Testing, Adjusting and Balancing
   2. 23 06 00 Pipe and Pipe Fittings
   3. 23 63 00 Water Treatment
   4. 23 74 00 Terminal Air Distribution Units
   5. 23 90 00 Controls and Instrumentation

1.3 START-UP PROCEDURES

A. Bearings:
   1. Inspect for cleanliness, clean and remove foreign materials.
   2. Verify alignment.
   3. Replace defective bearing and those which run rough or noisy.
   4. Lubricate as necessary in accordance with manufacturer's recommendations.

B. Motors:
   1. Check each motor for amperage comparison to nameplate value.
   2. Correct conditions, which produce excessive current flow, which exist due to equipment malfunction.

C. Drives:
   1. Adjust tension in V-belt drives, and adjust vari-pitch sheaves and drives for proper equipment speed.
   2. Adjust drives for alignment of sheaves and V-belts.
   3. Clean and remove foreign materials before starting operation.

D. Pumps:
   1. Check mechanical seals for cleanliness and adjustment before running pump.
   2. Inspect shaft sleeves for scoring.
   3. Inspect mechanical faces, chambers and seal rings; replace if defective.
   4. Verify that piping system is free of dirt and scale before circulating liquid through pump.
   5. Clean suction strainers.

E. Control Valves:
   1. Inspect hand and automatic control valves, clean bonnets and stems.
   2. Tighten packing glands to assure no leakage, but permit valve stems to operate without galling.
3. Replace packing on any valve, which continues to leak.
4. Remove and repair bonnets, which leak.
5. Coat packing gland threads and valve stems with surface preparation after cleaning.
6. Verify that control valve seats are free from foreign materials and are properly positioned for intended service.

F. Water Systems:
   1. Tighten flanges after system has been placed in operation. Replace flange gaskets, which show signs of leakage after tightening.
   2. Inspect screwed joints for leakage. Promptly remake each joint, which appears to be faulty; do not wait for rust to form.
   3. After water system has been placed in operation, clean strainers, dirt pockets, orifices, valve seats and headers in fluid systems to assure being free of foreign materials.
   4. Remove rust, scale and foreign materials from equipment and renew defaced surfaces.
   5. Inspect each electrical control circuit to assure that operation complies with specifications and requirements to provide desired performance.
   6. Inspect each pressure gauge and thermometer for calibration. Replace items defaced, broken or read incorrectly.
   7. Repair damaged insulation.

G. Air Systems:
   1. Set and calibrate draft gages of air filters and other equipment.
   2. Replace filter media with new clean units.
   4. Check each electrical control circuit to assure that operation complies with specifications and requirements to provide desired performance.

H. Adjustments:
   1. Provide such periodic continuing adjustment services as necessary to insure proper functioning of mechanical systems after occupancy of the Project, and for a period of one year after Date of Substantial Completion.
   2. Note: Adjustment services are not maintenance services.

PART 2 - PRODUCTS
--- NOT USED ---

PART 3 - EXECUTIONS
--- NOT USED ---

END OF SECTION
SECTION 26 0500
ELECTRICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Applicable provisions of Division 1 shall govern Work under this Section.

B. Furnish all labor, materials, equipment and accessories required to complete all electrical work as shown on the Drawings and specified herein, and shall include, but is not necessarily limited to:

26 05 00 Electrical General Provisions
26 11 00 Raceways and Boxes
26 12 00 Low Voltage Conductors and Cables
26 14 00 Wiring Devices
26 16 00 Service and Distribution
26 16 20 Panelboards
26 18 50 Equipment Connections
26 19 00 Supporting Devices
26 32 00 Packaged Generator Assembly
26 36 00 Transfer Switches
26 45 00 Grounding and Bonding
26 51 00 Interior Building Lighting
26 51 10 Lighting Control Systems

C. Work Included in Division 26:

1. General: The mention hereinafter of article, operation, material, equipment or method requires that the E.C. shall provide such article of quality noted, in the quantity required, shall perform each operation, and use such method, material or equipment prescribed, all in complete accordance with the conditions stated. The E.C. shall provide all materials, labor, tools, equipment and transportation as necessary to complete the project in conformity with the drawings, the specifications, and other Contract Documents. In general, this work includes everything essential for a complete electrical system in operating order as shown or implied on the drawings or hereinafter specified.

2. All work shall be in accordance with all Local & State Inspection Authorities having jurisdiction together with the recommendations of the manufacturer whose equipment is to be supplied and connected by the E.C. All materials shall bear a UL label where a UL Standard and/or test exists.

3. Before submitting his bid, each bidder shall examine the drawings relating to this work and shall become fully informed as to the extent and character of the work required and its relation to other work in the building. No consideration will be granted for any alleged misunderstanding of materials to be furnished or work to be done, it being understood that the tender of a proposal carries with it the agreement to all items and conditions referred to herein or indicated on the accompanying drawings.

4. The E.C., in conjunction with the Engineer's representative, shall establish exact location of all materials and equipment to be installed in consideration of construction features, equipment of other trades and requirements and purpose of equipment installed by the E.C.

D. Summary of Electrical Work:

1. Drawings and Specifications: Electrical drawings are schematic. Minor relocations of these items may be made by the Engineer prior to rough in at no expense to the Owner.

2. Any conflict between the drawings and specifications shall be brought to the attention of the Engineer.

3. Note that the electrical drawings are only a portion of the complete set of plans. The complete set of plans shall be used to define the electrical work.

4. The complete specifications will be utilized to define the electrical work.

5. General Outline: The facilities and systems of the electrical work can be described (but not by way of limitation) as follows:
   a. Provide new lighting, electrical devices and distribution.
   b. Provide provide standby generator back-up power.
E. Coordination of Electrical Work:

1. General: The Contractor shall confer with the other trades and the Engineer so that all concerned will be thoroughly familiar with the specific items and areas of the coordination.
2. Conflicts of any type shall be immediately reported to the Engineer.
3. The Contractor shall furnish and be responsible for the proper installation of all reinforcement required for wall or ceiling attached equipment.
4. Arrange electrical work in a neat, well organized manner with conduit and similar services running parallel with primary lines of the building construction.
5. Locate operating and control equipment properly to provide easy access, and arrange entire electrical work with adequate access for operation and maintenance.
6. All conduit shall be concealed except in mechanical and electrical rooms.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

1.3 DEFINITIONS

A. Provide: Furnish and install, complete and ready for service.
B. Exposed: Exposed to view in any room, corridor or stairway.
C. E.C.: Electrical Contractor.
D. Architect: Dimension IV Madison
E. The Engineer: HEIN Engineering Group.
F. The Owner: Village of Windsor
H. ANSI: American National Standards Institute
I. NEC: National Electric Code
J. NEMA: National Electric Manufacturers Association
K. NFPA: National Fire Protection Association
L. UL: Underwriters Laboratories, Inc.

1.4 PERMITS AND LICENSES

A. Prepare and submit to all authorities having jurisdiction, for their approval, all applications and working drawings required by them. Secure and pay for all licenses and permits required.

1.5 QUALITY ASSURANCE, STANDARDS AND SYMBOLS

A. General: Specifically, for the electrical work (in addition to standards specified in individual work section), the following standards are imposed, as applicable to the work in each instance:

1. Standards for Materials and Workmanship: All materials shall conform to the standard of the UL in every case where the UL has established a standard of such materials. In addition, these materials shall bear the UL label to show their conformance. Materials not covered by UL standards shall be processed, supplied or manufactured to NEMA, IEEE, or other accepted industry standards for these materials and shall also be labeled or properly identified as being in conformance with the appropriate standards. Substitute standards for those listed are not acceptable. Materials and equipment shall be
protected during delivery and handling to prevent damage; and shall be stored in a clean dry area to prevent contamination. Damaged materials shall not be used.

2. All materials and work shall conform to the applicable portions of the latest issues of the following standards:
   a. UL
   b. NEMA
   c. NEC
   d. NECA
   e. ANSI
   f. IEEE
   g. ASTM
   h. NFPA
   i. IPCEA
   j. FM
   k. ETL

3. All work shall be installed in accordance with National and State laws, ordinances and regulations. Comply with all applicable OSHA regulations.
   a. IBC
   b. IECC

4. All materials shall have a UL label where a UL Standard and/or test exists.

5. All work shall be executed in a neat and workmanlike manner by workers thoroughly qualified in the trade of duties they are to perform. A rough or unworkmanlike installation will be cause for removal and replacement of said installation.

B. Substitution of Materials:

1. All requests for substitution shall be in writing and shall include sufficient product information to permit the Architect/Engineer to evaluate the request.

2. The Architect/Engineer specifically reserves the right to reject or approve any and all substitute materials or equipment in order to insure compliance with the minimum standards of quality established for the project herein specified, and also to insure that any substitute materials or equipment maintains the trends of style and appearances established for this project.

3. When an item is approved as an equal, either by specification or by approved substitution, this item shall give the same end results, to the Architect/Engineer's satisfaction, as the item it has replaced from the specification. Any modification, additional fittings or change to the approved item or to concomitant items to accomplish these results shall be at the expense of the Contractor.

4. The Contractor shall choose from the listed manufacturers for specific items or a substitute manufacturer if approved, but once a manufacturer has been chosen all similar items shall be by the same manufacturer.

1.6 JOB CONDITIONS

A. Job Site:

1. The Contractor shall be familiar with conditions which will affect his work, and locations where the work will be performed and other pertinent factors.

2. The Contractor shall furnish all labor and materials to complete each installation ready for use.

3. No additional allowances will be granted because the Contractor's knowledge of job site conditions was incomplete.

B. Products, Electrical Work:

1. Product Listing: Prepare the product listing for electrical work. Include listing of each significant item of equipment and material used in the work; and indicate the generic name, product name, manufacturer, model number, related specification number(s).
   a. Submit list to the Architect/Engineer for approval.

2. Compatibility: Provide products which are compatible with other products of the electrical work, and with other work requiring interface with the electrical work, including electrical connections and control devices. For exposed electrical work, coordinate colors and finishes with the other work.
1.7 WORK SEQUENCE
A. The Contractor shall review the work sequence and determine if any dates of completion can not be met for his work. Any conflicts with completion dates shall be brought to the Engineer's attention prior to submitting a bid. No time extensions will be granted after contracts are awarded unless permitted in other parts of these specifications.

1.8 DIMENSIONS AND DEFINITE LOCATIONS
A. The drawings depicting electrical work are diagrammatic and depict, in their approximate location, symbols representing electrical equipment. The exact location shall be established in the field in accordance with instructions from the Architect.

B. Unless specifically stated to the contrary, no measurement of an electric drawing by scale shall be used as a dimension to work by. Dimensions noted on the electric drawings are subject, in each case, to measurements of adjacent or previously completed work and all such measurements necessary shall be taken before undertaking any work dependent upon time.

1.9 DRAWINGS
A. The E.C. shall prepare, at his expense, complete field installation drawings necessary for the proper installation of his work. These drawings shall be submitted to the Engineer when requested for review and such copies of same as are necessary shall be provided for others as directed.

B. The E.C. shall keep a detailed record, up-to-date, of the manner and location in which all installations are actually made, properly indexing each feeder, pull box and protective device.

C. As Built Drawings: See General Requirements - Division 1.

D. In the event of a conflict between the drawings and specifications the E.C. shall base his bid on the greater quantity, cost or quality of the item in question, unless such conflict is resolved by addenda.

1.10 MATERIALS AND EQUIPMENT
A. Provide all new materials and equipment to form a complete installation, unless otherwise specified.

B. All equipment supplied shall be based on materials and equipment of manufacturers specified. No substitutions will be allowed except as provided in Instructions to Bidders.

C. All items specified shall be the latest type or model produced by the manufacturer specified. If descriptive specification or model number is obsolete, substitute current product.

1.11 FLOOR, WALL AND CEILING OPENINGS
A. Pipe sleeves must be set for all pipes passing through new masonry construction. Coordinate with G.C. as to size and location of openings.

B. Coordinate the location of sleeves, openings, chases, furred spaces, etc., with the other Contractors. Provide all sleeves, hangers and inserts that are to be built into the structure during the progress of construction.

C. Pipe sleeves shall be Schedule 40 galvanized steel pipe and shall extend completely through the construction.

D. Sleeves for pipe 4" and smaller shall be at least two pipe sizes larger than the pipe passing through.

E. Sleeves shall extend 3/8" above the finished floor. In mechanical rooms and other areas where water may accumulate, sleeves shall extend 2" above the finished floor.

F. Pack annular space between sleeves and insulation or pipe with fiberglass. Where penetrations occur through mechanical rooms or fire rated walls, floors, fill with Dow-Corning 3-6548 Silicone RTV Foam.
1.12 SHOP DRAWINGS

A. Submit to Engineer for review, in accordance with Division 1, shop drawings and/or equipment brochures for the following:

1. Electric Distribution Equipment and Panelboards.
2. Raceways and Boxes.
3. Disconnects and Starters.
4. Low Voltage Conductors and Cables.
5. Wiring Devices.
7. Lighting Controls.
8. Standby generator package and transfer switch.

B. Submit in advance of construction requirements and as to cause no delay in the E.C.’s work and to allow the Engineer reasonable time to review them to make necessary corrections.

C. All data submitted for Engineer’s review shall be numbered consecutively, shall be noted to correlate with the electrical drawings and shall bear the name and location of the project, the name of the E.C., the date of submittal, the date of the drawings and the date of each correction and revision. If more than one type of lighting fixture (or other materials) are on submitted sheet, the one specified shall be conspicuously checked with red pencil by the E.C.

1.13 DELIVERY STORAGE AND HANDLING

A. All materials shall be suitably stored and protected prior to installation and all work shall be protected after installation, during construction and all work prior to acceptance.

B. The E.C. shall furnish and remove upon completion of the project, all scaffolding, rigging, hoisting and services necessary for delivery, erection and installation of all equipment and apparatus required to be installed by the E.C.

1.14 MAINTENANCE MANUALS

A. The E.C. shall assemble and submit to the Architect for subsequent submission to the Architect/Engineer, in accordance with Division 1, complete sets of a Manual of Operation and Maintenance for each of the separate systems furnished as a part of the electrical subcontractor.

B. Each manual shall consist of an approved loose-leaf type bound volume instructing the Architect/Engineer’s personnel in the use, operation and maintenance of the system in question. The manual shall cover all phases of operation of the equipment and it shall be illustrated with photographs, drawings, wiring diagrams, etc., as required to accurately and adequately describe the operation, construction and adjustable features of the complete system and each component part. The manual shall be complete with an equipment parts listing to facilitate the ordering of spare and replacement parts.

C. Each manual shall contain two sets of final shop drawings depicting equipment as installed.

1. Equipment Parts Lists: Include a complete list of all equipment furnished for project, with a tabulation of descriptive data of all the equipment replacement parts proposed for each type of equipment or system. Properly identify each part of part number and manufacturer.

1.15 CLEANING AND PAINTING

A. All rubbish resulting from this work shall be removed and disposed of on a daily basis and in such manner as to be acceptable to the Architect.

B. The E.C. shall clean all exposed ironwork, interior and exterior of panels and pull boxes, etc., and remove all rubbish and debris resulting from the work.

C. Where painted surfaces of equipment have been abused, removed, or rusted during construction, the E.C. shall paint same to match original factory or surrounding finish.
1.16 TESTS AND ACCEPTANCE

A. The operation of the equipment and electrical installations done does not constitute an acceptance of the work by the Architect/Engineer. The final acceptance is to be made after the E.C. has adjusted his equipment and demonstrated that it fulfills the requirements of the drawings and the specifications.

B. After the work is completed and prior to acceptance, the E.C. shall conduct the following tests, tabulate data, date, sign and submit to the Engineer: clamp ammeter test on each feeder conductor with all utilization equipment energized. The load current in each phase conductor of the feeder of the portion thereof supplying the panel shall not differ from the average connected load currents in the several conductors by more than 10%. If the load current does differ by more than 10%, the E.C. shall change phase loading to same or receive written approval from the Engineer that this is not required due to the nature of the load.

C. At the time of connection, or energizing, check all motors for proper rotation, conferring with contractor furnishing equipment, if necessary, to determine proper direction.

D. Upon completion of the installation, the E.C. shall furnish certificates of approval from all authorities having jurisdiction. He shall demonstrate that all work is complete and in perfect operating condition, with raceway and conduit system properly grounded, all wiring free from grounds, shorts, and that the entire installation is free from any physical defects. In the presence of the Engineer and the Architect/Engineer, the E.C. shall demonstrate the proper operation of all miscellaneous systems.

E. All materials and workmanship is subject to inspection, examination and tests by the Architect/Engineer at any time.

1.17 EXTRA STOCK/SPARE PARTS

A. None anticipated for electrical work.

1.18 DEFECTS

A. Should it be found by the Engineer that the fixtures, equipment or any portion thereof furnished and installed under this subcontract fail to comply with the specifications and drawings, with respect or regard to the quality, amount of value of material, appliances or labor used in the work, it shall be rejected and replaced by the E.C. and all work disturbed by changed necessitated in consequence of said defects or imperfections shall be made good at the E.C.'s expenses.

1.19 WARRANTY

A. The Contractor shall warranty: All materials furnished to be perfect in every respect; and, if not, replace same immediately. Replace any material or part showing defects within a minimum of one year of acceptance, or within warranty period of the item if greater than one year. This one-year warranty period shall be binding even though it may exceed the product warranty period normally furnished by some manufacturers. Repair or replacement shall bear an additional 12 months warranty as called for, dated from final acceptance of the repairs or replacement. The apparatus to be installed in strict accordance with these specifications and the various codes covering this work. Neither the final acceptance nor any provisions in the Contract Documents shall relieve this Contractor of the responsibility for negligence, faulty materials or workmanship within the extent and period provided by this contract.

1.20 IDENTIFICATION

A. General:

1. Materials and equipment shall be clearly identified as listed below.
2. Locate identification conspicuously.
3. Terminology to be approved by Architect.
4. See plans for any additional items to be identified.
5. Loads such as motors shall be described by function rather than by the system of arbitrary number as shown on electrical plans.
6. Use abbreviations sparingly.
B. All panels and cabinets shall be stenciled with 2” letters indicating usage, plan designation and voltage. In Equipment and Mechanical Rooms this identification may be on the exterior of unit; in other areas identification shall be inside door or cover.

C. Junction and pull boxes shall be stenciled utilizing a coded identification system. The following junction and pull boxes shall be identified using a coded system. Coding shall be submitted to Engineer for approval.
   1. Light and Power - 120/208V.

D. On all 3-phase systems, each phase shall be identified at all terminals using code markers.

E. Laminated Bakelite Plates: Engraved plastic nameplate shall be securely fastened to the following equipment. Size 1” x 4” with 3/8” high letters unless space available dictates differently.
   1. Each section of main distribution switchboards and panelboards. Mount one next to each protection device to identify load served by each circuit breaker.
   2. Each contractor, time switch, metering cabinet, starter, motor disconnect switch. In Equipment and Mechanical Rooms this identification may be on the exterior of unit, in other areas identification shall be inside door or cover.
   3. Each feeder at all accessible locations, i.e., panels, junction boxes, pull boxes, etc. (strap plate to feeder conductors in junction boxes or pull boxes).
   4. Each end of empty conduit runs to indicate the intended use of the conduit and the location of opposite end. Use room numbers that are permanently assigned.

F. Typewritten Directory: Each panelboard shall be provided with a typewritten directory in a steel frame with plastic cover contained on the inside of panel door. These directories shall indicate load served and rooms served by each protective device in the respective panel.

G. Conductor Identification:
   1. Identify each conductor at each conductor or splice point with permanently attached wrap around adhesive markers as manufactured by Brady Company.
   2. This identification shall include branch circuit number, control circuit number, or any other appropriate number or lettering that will expedite future tracing and “trouble shooting”.
   3. All wire shall be color-coded per the NEC. In addition, color-coding shall be used to identify phases, neutral, ground and voltages. Coding shall be:
      120/208V - Phase A - Black
      - Phase B - Red
      - Phase C - Blue
      - Neutral - White
      - Ground - Green

1.21 ACCESS PANELS

A. Access panels required by code or otherwise to electrical equipment shall be provided by Electrical Contractor. Access panels shall be in accordance with Division 1 complete with master cylinder lock.

PART 2 - PRODUCTS

--- Not Used ---

PART 3 - EXECUTION

--- Not Used ---

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION

A. Provide complete raceway system as specified for power, standby and emergency power systems.

1. Conduit, box and raceway systems.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

1. 26 05 00 Electrical General Requirements
2. 26 12 00 Low Voltage Conductors and Cables
3. 26 19 00 Supporting Devices
4. 26 45 00 Grounding and Bonding

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. National Electrical Code, NEC: Comply with NEC/NFPA No. 71 as applicable to construction and installation of electrical conduit.
2. National Electrical Manufacturer's Association, NEMA: Comply with applicable portions of NEMA standards pertaining to non-metallic duct and fittings for underground installation.
3. Underwriters Laboratories: Provide electrical conduit listed and labeled by UL.

1.4 DELIVERY, STORAGE AND HANDLING

A. Provide color-coded end-cap thread protectors on exposed threads of threaded metal conduit.

B. Storage:

1. Store pipe and tubing inside and protect from weather.
2. When necessary to store outdoors, elevate well above grade and enclose with durable, watertight wrapping.

C. Handle conduit and tubing carefully to prevent bending and end damage and to avoid scarring the finish.

PART 2 - PRODUCTS

2.1 APPROVED MANUFACTURERS

A. Conduit:

1. Allied Tube and Conduit Corporation.
2. Wheatland Tube Company.
3. Steelduct Conduit Products.

B. Couplings:

1. Appleton Electric Company.

C. Flexible Conduit:

1. Anaconda Metal Hose.
2. I.B.C. Corporation.
3. Electri-Flex Company.

D. Boxes:

1. Appleton Electric Company.
5. Lew Electric Fitting Company.
7. Raco, Inc.
8. Square D Company.
9. Steel City Division.
10. Thomas and Betts Company, Inc.
11. Wiremold/Walker.

2.2 CONDUIT MATERIAL

A. RIGID METAL CONDUIT AND FITTINGS

1. Conduit: Heavy wall, galvanized steel, schedule 40, threaded.
2. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

B. INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

2. Fittings and Conduit Bodies: Use all steel threaded fittings and conduit bodies.

C. ELECTRICAL METALLIC TUBING (EMT) AND FITTINGS

1. Conduit: Steel, galvanized tubing.
2. Fittings: All steel, set screw, concrete tight. No push-on or indenter types permitted. Conduit Bodies: All steel threaded conduit bodies.

D. FLEXIBLE METAL CONDUIT AND FITTINGS

2. Fittings and Conduit Bodies: All steel, galvanized, or malleable iron.

E. LIQUIDTIGHT FLEXIBLE METAL CONDUIT AND FITTINGS

1. Conduit: flexible, steel, galvanized, spiral strip with an outer Liquidtight, nonmetallic, sunlight-resistant jacket.
2. Fittings and Conduit Bodies: ANSI/NEMA FB 1, compression type. There shall be a metallic cover/insert on the end of the conduit inside the connector housing to seal the cut conduit end.

F. CONDUIT

1. **Rigid Threaded:** Steel, ANSI C80.1
2. **Electrical Metallic Tubing:** ANSI C80.3
3. **Rigid Nonmetallic Tubing:** Schedule 40 PVC; NEMA TC-2 & WC-1094

2.3 BOXES MATERIAL
A. OUTLET BOXES

1. Sheet Metal Outlet Boxes: galvanized steel, with stamped knockouts.
2. Luminaire and Equipment Supporting Boxes: Rated for weight of equipment supported; include 3/8 inch male fixture studs where required.
3. Concrete Ceiling Boxes: Concrete type.
4. Cast Boxes: Cast ferroalloy, or aluminum type deep type, gasketed cover, threaded hubs.
5. Boxes:
   a. Metallic hot-dipped galvanized, 1.25 oz. per square foot or cadmium plated.
   b. Non-metallic, PVC thermoplastic or thermoset polyester.
6. Interior Boxes:
   a. Pressed sheet steel, blanked for conduit.
   b. Provide attached lugs for locating.
7. Exterior Boxes: Cast aluminum, deep type, corrosion proof fasteners, water tight, gasketted with threaded hubs.
8. For Ceiling: 4-inch octagon boxes for 1 fixture, including fixture studs and maximum 2 connecting conduits.
9. For Flush Mounting in Walls:
   a. Boxes with matching plaster cover for single or two gang outlets.
   b. Two-gang box or larger or deep masonry box for conductors, conductor joints, conduit terminations and wiring devices.
10. Surface Mounted: 4 inches square.

B. PULL AND JUNCTION BOXES

Pull boxes and junction boxes shall be minimum 4 inch square by 2-1/8th inches deep for use with 1 inch conduit and smaller. On conduit systems using 1-1/4 inch conduit or larger, pull and junction boxes shall be sized per NEC but not less than 4-11/16 inch square.

1. Sheet Metal Boxes: code gauge galvanized steel, screw covers, flanged and spot welded joints and corners.
2. Sheet Metal Boxes Larger Than 12 Inches (300 mm) in any dimension shall have a hinged cover or a chain installed between box and cover.
3. Cast Metal Boxes for Outdoor and Wet Location Installations: Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as raintight. Galvanized cast iron or aluminum box and cover with ground flange, neoprene gasket, and stainless steel cover screws.
4. Box extensions and adjacent boxes within 48” of each other are not allowed for the purpose of creating more wire capacity.
5. Junction boxes 6” x 6” or larger size shall be without stamped knock-outs.
6. Wireways shall not be used in lieu of junction boxes.
7. Pull Boxes and Junction Boxes: NEC metal construction with screw or hinged cover.

C. CONDUIT BODIES:

1. Galvanized or aluminum cast-metal of type, shape and size to fit each respective location.
2. Constructed with threaded conduit ends, removable cover and corrosion-resistant screws.

D. BUSHINGS, KNOCKOUT CLOSURES AND LOCKNUTS: Provide corrosion-resistance punched-steel box knockout closures, conduit locknuts and malleable iron conduit bushing, type and size to suit respective use.

E. POWER POLES: Steel dual channel raceways with knockouts for voice/data devices on the communication channel and receptacles devices on the power channel. A full compliment of fittings for the Power Pole shall be available including, but not limited to, entrance end fitting for top of the electrical channel, ceiling trim plate, pole-mounting bracket.

1. Power poles shall be equal to Legrand Wiremold 25DTP series.
2. Field measure required heights prior to ordering.

PART 3 - EXECUTION
3.1 CONDUIT INSTALLATION

A. Wiring: All wiring shall be installed in raceways as herein specified. All raceway runs shown on the drawings are diagrammatic; exact locations shall be determined in the field.

1. Conceal all conduit in finished areas.
2. Concealed raceways shall be installed in the walls, above ceilings, below floors or in furred out spaces so as to be completely concealed from view by occupants during their normal activities in use of the space.
3. Exposed raceways shall be run in straight lines at right angles or parallel with walls, beams and columns.
4. Provide raceways as required by the access control equipment controls for door operating and monitoring.

B. Raceway Installation: All raceways, which are not buried or embedded in concrete shall be supported by straps, suitable clamps or hangers to provide a rigid installation. Perforated strap or wire hangers will not be acceptable. In no case shall raceways be supported or fastened to other pipe. No raceway smaller than 1/2" shall be used, except that light fixture switch legs may be 3/8".

1. Bends: Not more than three 90 degree bends will be allowed in one raceway run. Where more bends are necessary, a conduit or pull box shall be installed. All bends in 1" and smaller conduit or electrical metallic tubing shall be made with proper bender. All other bends shall be machine made.
2. Joints: Joints in rigid metal shall be threaded type made up watertight with white lead or compound applied to male threads only and all field joints shall be cut square, reamed smooth and properly threaded to receive couplings. Electrical metallic tubing systems shall utilize watertight compression type fittings throughout. No indenter type fittings or running threads will be permitted.
3. Locknuts: Double locknuts shall be provided on all conduit terminations with the exception of conduits terminating in threaded hubs and couplings. Locknuts shall be of a type that have sharp beveled teeth that dig into the metal when tightened and will not loosen through vibration.
4. Bushing: Bushing shall be provided on all conduits with the exception of conduits terminating in hubs and couplings. Insulating bushings consisting of insulating inserts in metal housing shall be provided on all installations. Insulating bushings shall be grounding type where required by the National Electrical Code.
5. Heating Ducts and Pipes: Care shall be used to avoid proximity to heating duct and hot water lines. Where such crossings are unavoidable, raceway shall clear covering or line by at least 6".

C. Utilize rigid steel conduit or rigid nonmetallic conduit where exposed to moisture, buried in earth or in concrete.

D. Utilize electrical metallic tubing (EMT) or intermediate metal conduit in other above-grade locations.

E. For underground conduit: use PVC-coated rigid conduit or rigid non-metallic conduit.

F. Connections:

1. Motors and equipment: Minimum 1/2" size; PVC jacketed flexible conduit and liquid-tight connectors.
2. Flexible conduit sufficient length to avoid vibration transmission.
3. Use 3/8" flexible conduit only for light fixture whips (72" max.) and control wiring.
4. Coordinate service conduit connections with location of service transformers.

G. Install conduit and tubing products as indicated, in accordance with manufacturers written instructions and applicable requirements of NEC and NEMA Standard and Installation.

H. Install conduit concealed in all areas excluding mechanical, electrical and other unfinished rooms, connections to motors and connections to surface cabinets.

I. Coordinate installation of conduit in masonry work.

J. Do not install conduit larger than 1" in concrete slabs.
K. Install conduit free from dents and bruises.

L. Plug conduit end to prevent entry of dirt or moisture.

M. Clean out conduit before installation of conductor.

N. Alter conduit routing to avoid structural obstructions, minimizing cross-overs.

O. Seal conduit with oakum or fiberglass where conduits leave heated area and enter unheated area.

P. **Roof Penetrations:** Provide flashing and pitchpockets making watertight joints where conduits pass through roof or waterproofing membrane.

Q. **Building Expansion Joints:**
   1. Install UL listed expansion fittings complete with grounding jumpers where conduits cross building expansion joints.
   2. Provide bends or offsets in conduits adjacent to building expansion joints where conduit is installed above suspended ceiling.

R. Route all exposed conduits parallel or perpendicular to building lines.

S. Allow minimum 6" clearance at flues, steam pipes and heat source.

T. **Underground Conduit:** Direct burial minimum.
   1. Support multiple runs vertically and horizontally with plastic spacers 8' on center.
   2. Slope conduit to drainage point.
   3. Adjust final layout to coordinate with existing utilities.
   4. Trench and backfill as detailed on drawings.
   5. Encase conduit with 3" concrete cover under driveways.

U. Cap all spare conduits.

V. Provide all empty raceways with a heavy duty nylon cord, full length of raceway. Tag cord for identification.

W. Maintain safe clearances from hazardous adjacent equipment, hot water piping, flues, high temperature piping, ductwork, etc.

3.2 **CONDUIT INSTALLATION SCHEDULE**


B. Within Concrete Slab: Rigid steel conduit. Schedule 40 PVC conduit. Electrical Nonmetallic Tubing (ENT).

C. Wet Interior Locations: Rigid steel conduit. Schedule 40 PVC conduit.


F. Motor and equipment connections: Flexible PVC coated metal conduit (all locations). Minimum length shall be one foot (300 mm), maximum length shall be three feet (900 mm). Conduit must be installed perpendicular to direction of equipment vibration to allow conduit to freely flex.

G. Light fixtures: Direct box or conduit connection for surface mounted and recessed fixtures. Flexible metal conduit from a J-box for recessed lay-in light fixtures. Conduit size shall be 3/8" minimum diameter and six foot (1.8 M) maximum length. Conduit length shall allow movement of fixture for maintenance purposes.
F. In areas where the walls cannot be fished, the station cable serving these outlets shall be covered with raceways. No exposed wire shall be permitted within offices, laboratories, and conference rooms or like facilities.

G. The non-metallic raceway shall have a screw applied base. Both the base and cover shall be manufactured of rigid PVC materials.

H. The raceway shall originate from a surface mounted box mounted adjacent to and at the same height as existing electrical boxes in the room, be attached to the wall and terminate above the ceiling.

I. All fittings including, but not limited to, extension boxes, elbows, tees, fixture bodies shall match the color of the raceway.

J. The raceway and all systems devices shall be UL listed and exhibit nonflammable self extinguishing characteristics, tested to specifications of UL94V-0.

K. The raceway and all systems devices shall adhere to the EIA/TIA Category 5e bend radius standard.

3.3 BOX INSTALLATION

A. Pull Boxes and Junction Boxes: Locate pull boxes and junction boxes above removable ceilings or in electrical rooms, utility rooms or storage areas.

B. Outlet Boxes:
   1. Mount outlet boxes flush in area other than mechanical rooms, electrical rooms and above removable ceilings.
   2. Adjust position of outlets in finished masonry walls to suit masonry course lines.
   3. Do not install boxes back-to-back in same wall.
   4. Masonry Walls:
      a. Coordinate cutting of masonry walls to achieve neat openings for boxes.
      b. Locate boxes in masonry walls so that only corner need be cut from masonry walls.
   5. Do not use sectional or handy boxes unless specifically requested.
   6. For boxes mounted in exterior walls, make sure that there is insulation behind outlet boxes.
   7. For outlets mounted above counters, benches or splashbacks, coordinate locations and mounting heights with built-in units.
   8. Adjust outlet mounting height to agree with required location for equipment served.

C. Boxes supplied by others: Verify exact mounting location and type of mounting.

D. Provide knockout closures to cap unused knockout holes where blanks have been removed.

E. Support all boxes independently of conduit.

3.4 COORDINATION OF BOX LOCATIONS

A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
   1. Electrical box locations shown on Contract Drawings are approximate unless dimensioned. Verify location of floor boxes and outlets in offices and work areas prior to rough-in.
   2. No outlet, junction, or pull boxes shall be located where it will be obstructed by other equipment, piping, lockers, benches, counters, etc.
   3. Boxes shall not be fastened to the metal roof deck.

B. It shall be the Contractor's responsibility to study drawings pertaining to other trades, to discuss location of outlets with workmen installing other piping and equipment and to fit all electrical outlets to job conditions.
   1. If any question arise over the location of an outlet, the Contractor shall refer the matter to the Architect/Engineer and install outlet as instructed by the Architect/Engineer.
2. The proper location of each outlet is considered a part of this contract and no additional compensation will be paid to the Contractor for moving outlets which were improperly located.

C. Locate and install boxes to allow access to them. Where installation is inaccessible, coordinate locations and provide 12 inch by 12 inch access doors.

D. Locate and install to maintain headroom and to present a neat appearance.

E. Install boxes to preserve fire resistance rating of partitions and other elements, using approved materials and methods.

3.5 PULL AND JUNCTION BOX INSTALLATION

A. Locate pull boxes and junction boxes above accessible ceilings, in unfinished areas or furnish and install approved access panels in non-accessible ceilings where boxes are installed. All boxes are to be readily-accessible.

B. Support pull and junction boxes independent of conduit.

END OF SECTION
SECTION 26 1200
LOW VOLTAGE CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Provide all wires and cables required for a complete electrical system, excluding voice, data, security camera, DVR cabling and door access which are by Owner.

1.2 RELATED WORK

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

1. 26 11 00 Raceways and Boxes

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. National Electrical Code, NEC: Comply with NEC/NFPA No. 70, as applicable to construction and installation of electrical cable, wire and connectors.

2. Underwriter Laboratories, UL: Electrical cable, wire and connectors listed and labeled by UL.

B. References: National Electrical Manufacturers Association/Insulated Power Cable Engineer's Association, NEMA/IPCEA.

1.4 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Conductor sizes are based on copper.

C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet project conditions.

D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.5 DELIVERY, STORAGE AND HANDLING

A. Provide factory-wrapped waterproof flexible barrier material for covering wire and cable on wood reels, where applicable; and weather-resistant fiberboard containers for factory-packaging of cable, wire and connections to protect against physical damage in transit.

B. Store cable, wire and connectors in factory-installed coverings in clean, dry indoor space which provides protection against weather.

C. Do not install damaged cable, wire and connectors; remove from project site.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Wire and Cable:
1. Anaconda Wire and Cable Company.
2. Collyer Insulated Wire Company, Division.
3. Electrical Cable Division.
4. General Cable Corporation.
5. General Electric Company.
6. Phelps Dodge Cable and Wire Company.

**B. Connectors:**

1. AMP, Inc.
2. Burndy Corporation.
4. Ideal Industries, Inc.
5. 3M Company.
7. Thomas and Betts Company.
8. Buchanan.

### 2.2 MATERIALS

#### A. Wire and Cable:

1. 98% conductivity copper.
2. 600 volt insulation.
3. Branch circuit wiring #10 and smaller shall be solid or stranded THWN or THHN. Sizes #8 and larger stranded type THWN or THHN. Stranded wire shall be used for all motor connections regardless of size. Lighting fixture wiring shall be 90 deg C THHN.
4. Stranded conductors may only be terminated with UL OR ETL Listed type terminations or methods.
5. Conductors smaller than No. 12 AWG gauge not permitted except for alarm and signal circuits which may be #14 AWG minimum.
6. Color code and identify all wiring as specified in Section 16050.

#### B. Insulation:

- Type THHN/THWN, XHHW-2 insulation for feeders and branch circuits.
- Type XHHW-2 insulation for feeders with aluminum conductors.

#### C. Exterior Wiring:

Comply with NEC for wet location wiring.

#### D. Wiring for systems other than power:

1. Conform to system manufacturer standards as to size, type and coding, subject to specified minimums.
2. Size conduit as required by system manufacturer, but no smaller than shown.
3. Provide copper XHHW for exterior services.

#### E. Armored Cable (AC) or Metal-Clad Cable (MC):

1. Limit AC and MC usage to concealed only locations, branch-circuit wiring after the first junction box from the panelboards, where approved by NEC, state and local electrical inspecting authorities.
2. Not allowed for Panelboard feeders or service conduit.
3. Provide and install per NEC Articles 333 and 334 with grounding conductor.

### 2.3 WIRING CONNECTORS

#### A. Solderless Pressure Connectors:

High copper alloy terminal. May be used only for cable termination to equipment pads or terminals. Not approved for splicing.

#### B. Spring Wire Connectors:

Solderless spring type pressure connector with insulating covers or copper wire splices and taps. Use for conductor sizes 10 AWG and smaller.
C. All wire connectors used in underground or exterior pull boxes shall be gel filled twist connectors or a connector designed for damp and wet locations.

D. Mechanical Connectors: Bolted type tin-plated; high conductivity copper alloy; spacer between conductors; beveled cable entrances.

E. Split Bolt Connectors: Not acceptable.

F. Compression (crimp) Connectors: Long barrel; seamless, tin-plated electrolytic copper tubing; internally beveled barrel ends. Connector shall be clearly marked with the wire size and type and proper number and location of crimps.

G. Splices: Splices and taps for No. 10 or smaller shall be with twist-on insulated connectors. Splices in wire No. 8 and larger shall be made with split-bolt or compression connectors equal to Burndy Hydent requiring a tool and die application. Tape all non-insulated compression connectors to achieve full 600V insulation.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

A. All wire and cable shall be installed in conduit, unless specified.

B. Do not use wire smaller than 12 AWG for power and lighting circuits.

C. Conductors size indicated on drawings indicates ampacity requirements using copper conductors and type THHN insulation unless otherwise noted.
   1. Provide XHHW for exterior services.

D. All conductors shall be sized to prevent excessive voltage drop at rated circuit ampacity. As a minimum use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 100 feet (30 m), and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet (61 m).

3.2 INSTALLATION

A. Make conductor length for parallel feeders identical.

B. Lace or clip groups of feeder conductors at new panel board.

C. Install wire and cable in NEC Code conforming raceway.

D. Pulling:
   1. Use wire pulling lubricant for pulling No. 4 AWG and larger wire. Use special care to avoid overstraining of conductors.
   2. Pull conductors together where more than one is being installed in raceway.
   3. Do not use pulling means, including fish tape, cable or rope which can damage raceway.
   4. All raceways shall be thoroughly swabbed out with a dry swab to remove moisture and debris before conductors are drawn into place. All ends of raceways shall be tightly plugged with tapered plugs or capped bushings until the conduits are pulled to prevent water and debris from entering conduits. All conduits stubbed up through floors shall be capped and aligned during construction by the use of spacers and caps.

E. Install wire in conduit runs after concrete and masonry work is complete, conduit shall be clean and dry.

F. Splicing:
   1. Splice only in accessible junction boxes.
2. Install splices and taps which have equivalent or better mechanical strength and insulation as conductor.
3. Use splice and tap connectors which are compatible with conductor material.
4. **No. 10 and smaller joints**: Utilize connectors as hereinafore specified with PVC or nylon covers.
5. **No. 8 and larger joints**: Clean and join with tool and die compression type fitting.

### 3.3 WIRING INSTALLATION IN RACEWAYS

A. Pull all conductors into a raceway at the same time. Use Listed wire pulling lubricant for pulling 4 AWG and larger wires and for other conditions when necessary.

B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.

C. Completely and thoroughly swab raceway system before installing conductors.

D. Place all conductors of a given circuit (this includes phase wires, neutral (if any), and ground conductor) in the same raceway. If parallel phase and/or neutral wires are used, then place an equal number of phase and neutral conductors in same raceway or cable.

### 3.4 WIRING CONNECTIONS AND TERMINATIONS

A. Splice only in accessible junction boxes.

B. Wire splices and taps shall be made firm, and adequate to carry the full current rating of the respective wire without soldering and without perceptible temperature rise.

C. Use solderless spring type pressure connectors with insulating covers for wire splices and taps, 10 AWG and smaller.

D. Use mechanical or compression connectors for wire splices and taps, 8 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of the insulation value of conductor.

E. Thoroughly clean wires before installing lugs and connectors.

F. At all splices and terminations, leave tails long enough to cut splice out and completely re-splice.

**END OF SECTION**
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Applicable provisions of Division 1 shall govern work under this section.
B. Furnish and install all devices such as switches, receptacles, plates, etc., as shown on the drawings.

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 shall govern work under this section.
B. Specified Elsewhere:
   1. 26 11 00 Raceways and Boxes
   2. 26 18 50 Equipment Connections
   3. 26 45 00 Grounding and Bonding

1.3 SUBMITTALS
A. Submit products and technical data per Division 1 and Section 26 0500.
B. Wiring Device and plate color to be selected by Architect.

PART 2 - PRODUCTS

2.1 WALL SWITCHES
A. Wall Switches for Lighting Circuits and Motor Loads Under 1/2 HP: Heavy duty use toggle switch, rated 20 amperes and 120/277 volts AC. Switches shall be UL20 Listed and meet Federal Specification WS-896. All switches shall be heavy duty Specification Grade with separate green ground screw.
B. All switches shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG. Switches shall be Leviton model 1221-S, Hubbell model CS1221, Pass & Seymour model CSB20, Cooper model CSB120, or approved equal.
C. Handle: made of nylon or high impact resistant material.
D. Dimming Switches: Combination slider with toggle switch at bottom and LED indicator light. Dimmer switch shall be compatible with the type of LED lighting system under control as recommended by light fixture/driver manufacturer.
   1. 0-10 VDC Dimmer: Synergy ISD BC 120/277 IV(ivory) or approved equal.
   2. Electronic Low-voltage Dimmer: Synergy ISD 400 ELV 120 IV(ivory) or approved equal.

2.2 RECEPTACLES
A. Convenience and Straight-blade Receptacles: NEMA Type 5-15R or 5-20R, nylon impact resistant face. Receptacles shall be UL498 Listed and meet Federal Specification WC-596.
B. All duplex receptacles shall be heavy duty Specification Grade, 15 or 20-amp rated, as scheduled or shown on drawings. All receptacles shall be back and side wired, screw clamp type, suitable for solid or stranded wire up to #10 AWG, with a separate green ground screw. Receptacles shall be Leviton model 5362-S, Hubbell model...
CR5362, Pass & Seymour model CRB5362, Pass & Seymour model PT5362 with 90º connector, Cooper model 5362C, or approved equal.

1. Provide tamperproof receptacles where required by local code.

C. Generally, all receptacles shall be duplex convenience type unless otherwise noted.

D. Receptacles installed in damp or wet locations shall be UL listed weather resistant.

E. All receptacles installed in outdoor locations, in garages, within 6 feet of the outside edge of sinks, and in other damp or wet locations shall be GFCI type.

F. GFCI Receptacles: Duplex convenience receptacle, Specification Grade, with integral ground fault current interrupter meeting the requirements of UL standard 943 Class A and UL standard 498. GFCI receptacles shall be Leviton model 8899, Hubbell model GRF5352, Pass & Seymour model 2095 or approved equal.

G. All receptacles on emergency circuits shall have a red face.

H. All receptacles designated as isolated ground shall have an isolated ground triangle imprint on the face of the receptacle.

I. Locking-Blade Receptacles: As indicated on drawings.

2.3 DEVICE PLATES AND BOX COVERS

A. Receptacle Cover Plate: Specification Grade 302/304 smooth stainless steel or nylon construction.

1. Plate color to be selected by Architect.

B. Weatherproof Cover Plate: Gasketed metal with hinged device covers.

C. Surface Cover Plate: Raised galvanized steel.

D. Receptacles installed in damp or wet locations shall be UL listed weather resistant.

1. Provide as required for each outlet, single or multiple gang.

2. Provide blank covers on all empty boxes or outlets.

3. Galvanized steel box covers shall be used in unfinished areas. Cover shall be 1/2" raised with no sharp edges.

4. Provide single gang, die-cast, weather-resistant covers equal to Leviton #6196-V on receptacles in damp areas and exterior for in-use per NEC.

E. Any device switches or receptacles necessary for completion of the work, but not called for in the Contract Documents shall be furnished and installed by the Contractor as needed at no additional cost to the Owner. Such devices shall meet the intended standards described in this Section.

PART 3 - EXECUTION

3.1 GENERAL

A. Receptacles above counters shall be mounted vertically 6" above counter or high enough to miss backsplash if provided.

B. Receptacles required for equipment shall be located within 2 feet of that equipment if possible.

1. Receptacles for refrigerators, freezers and vending machines shall be mounted at 36" AFF.

2. Verify final mounting height required for electric water cooler with Plumbing Contractor.
C. Verify all device locations with General Contractor before rough in.

3.2 WIRING DEVICE INSTALLATION

A. Install wall switches 48 inches above floor, OFF position down.

B. Install convenience receptacles 18 inches above floor, grounding pole on bottom.

C. Install box for information outlet 18 inches above finished floor. Install box for telephone jack for wall telephone 54 inches above finished floor.

D. Install specific-use receptacles at heights shown on Contract Drawings.

E. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions.

F. Install device plates on switch, receptacle, and blank outlets in finished areas.

G. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface-mounted outlets.

H. Install devices and wall plates flush and level.

I. Receptacles shall have a bonding conductor from grounding terminal to the metal conduit system. Self-grounding receptacles using mounting screws as bonding means are not approved.

END OF SECTION
SECTION 16 1510
MOTORS AND MOTOR WIRING

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide motor branch circuit wiring, motor starters, and disconnect switches to make a complete code complying motor branch circuit for each motor on project.

B. Mounting of all equipment under this contract.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

1. 26 11 00 Raceways and Boxes
2. 26 15 50 Motor Starters
3. 26 17 00 Motor and Circuit Disconnects
4. 26 18 50 Equipment Connections
5. Division 22 Plumbing
6. Division 23 HVAC

C. Each motor shall have an individual means of disconnect within equipment cabinet in finished area. Adjacent to motor in sight of and within 25'-0" of motor in all other areas.

D. Disconnect shall be heavy-duty, horsepower-rated fused switch for three phase motors and fused toggle switch or manual fractional motor starter switch for single phase motors, unless noted otherwise in Motor Schedules or otherwise.

E. Enclosures for outdoor locations and those marked "WP" shall be NEMA Type 3R elsewhere, unless otherwise noted, enclosures shall be NEMA Type 1.

F. All controls shall be 120 volt or less. Control wiring shall have all controls wired in hot line (fused for three or more control devices and all fuel burners) with other side grounded. Control panel protected per NEC 430 and 440. Control wiring by contractor furnishing motor except as noted.

G. Contractor who furnished and installed motor or other current using equipment shall furnish to Electrical Contractor all line voltage(greater than 100 volts) control devices for installation.

1. Specified manual, automatic, local and remote motor and other control devices and switches, including thermostats, pressurestats, aquastats and other devices when specified as supplied by others.
2. Detailed wiring diagrams, installation and operating instructions in form of reviewed shop drawings for complete wiring installations of above equipment.
3. Motors will be set and aligned by contractor furnishing motor.

1.3 QUALITY ASSURANCE

A. Motor and related equipment shall conform to NEMA standards for the type and application.

PART 2 - PRODUCTS

2.1 MOTORS

A. Motors smaller than 1/2 HP: 120 V, single phase, 60-cycle current.
B. Motors 1/2 HP and larger:
   1. In accordance with NEMA Standards, unless otherwise indicated.
   2. 460V or 208V, 3-phases, 60-cycle current.

C. Characteristics: Quiet, non-overloading under operating conditions, 1.15 series factor, suitable for intended services, accessible for servicing and with oiling devices arranged for easy access.

D. Motor Protection:
   1. Motor protection integral with motor starter, thermal overload type, including manual reset.
   2. Automatic reset type overloads or built-in overload not acceptable.
   3. Provide motor protection for each speed of multiple speed motors.

E. Factory Wired Panels:
   1. Factory wired panels supplied as integral part of equipment provided by Division 15 Contractor.
   2. Factory wired panel includes responsibility for totally wired control system as indicated on control drawings by Division 15 Contractor.
      a. Furnished with completely integrated control panel, including switches, starters, certain disconnects, protective devices and control transformers mounted on associated mechanical equipment.
      b. "Factory wired panel" does not mean wired at factory, but does mean provided by the Heating, Ventilating or Plumbing Contractor specified in Division 15.
      c. In certain cases, as indicated, Electrical Contractor provides disconnect switch ahead of factory wired panel.

G. Temperature Control Panels: Electrical Contractor shall provide line voltage power to control panels as indicated on the Drawings and Schedules. Additional line voltage wiring requirements shall be the responsibility of the Temperature Control Contractor to retain an electrical trade to complete temperature control power requirements.

2.2 STARTERS - See Section 26 15 50 Motor Starters.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide wiring, disconnect devices, final connection to all equipment noted.

B. Furnish, install and wire all such electrical devices, controls, interlocks, including main, control and interlocking wiring, final connections and testing in full compliance with all requirements of contract.

C. Perform all such work under direct supervision of Contractor who provided motor or equipment. Latter Contractor shall have full responsibility for complete motor, current using device, controls and wiring installations, including all work done by Electrical Contractor and shall guarantee all such work as if he had installed it.

D. All conductors shall be stranded for motor feeders.

E. Provide liquid tight flexible conduits at motors and other vibrating equipment.

F. Grounding wire shall be provided in all flexible conduits. All motors shall be grounded per NEC 250.

G. When a motor box serves more than one motor and motor branch wire size is smaller than wire size in motor outlet box, motor branch shall be protected as required by NEC.
H. Examine the drawings and specifications covering all contracts to ascertain what equipment is furnished by others. Furnish the necessary labor and materials to wire said equipment unless material and wiring is called for under the specifications.

I. Locate and install control devices, as indicated. Coordinate requirements with all other trades.

J. In finished areas, mount motor protection switches flush and install suitable coverplates.

K. Install overload heater or related with full load current of motors provided. Provide actual field measurements of equipment operating under normal loads to verify proper heater selection.

L. Set all protective devices to suit motors provided.

M. Mount and wire all controlling equipment furnished in Division 15.

N. Verify motor sizes for starters, including verification of required number of auxiliary contacts.

O. Install all power and control wiring including conduit to and from starters to motors and to all remote devices required for complete system operation as indicated on drawings.

P. Install all motor starter, pilot lights, pushbuttons, selector switches, thermal overloads and local disconnect switches at motors, except those devices specified as part of integral factory wired panels or as provided under Division 15.

Q. E.C. is responsible for connections, proper phase relationships and motor rotation.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide and install motor starters where indicated on plans and elsewhere in these specifications.

B. Submittals: Provide submittal as required in 26 0500.

PART 2 - EQUIPMENT

2.1 MOTOR STARTERS

A. All motor starters shall be furnished by the Electrical Contractor unless otherwise noted. Starters shall be Siemens, Square D, or Cutler Hammer.

B. Magnetic starters shall be non-reversing, full voltage across-the-line type in a NEMA-1 enclosure; where located exterior provide NEMA 3R enclosure.


2. Each starter shall have 3 melting alloy overload protectors. See Drawings for size and voltage.

3. Auxiliary contacts required for interconnection of controlled equipment shall be furnished by the Electrical Contractor after consultation with the temperature control and other mechanical contractors.

4. When interlocking or automatic control of single-phase motors is required, motors shall have magnetic across-the-line starters.

5. Each starter shall be complete with magnetic circuit breaker and front operated position - indicating handle. Each circuit breaker shall have means of padlocking external operating handle in the off position.

6. The starter door shall be interlocked so that the circuit breaker must be “off” before the door can be opened. Each starter shall be equipped with a control transformer 208 or 480 volt, 2-wire primary and 120 volt, wire secondary.

7. Each control transformer shall be equipped with a Bussman type KTK fuse on the secondary side.

C. Manual starter shall have melting allow type trip-free thermal overload relays furnished in NEMA- enclosure with toggle switch disconnect and pilot light. Refer to Motor Schedule for sizes and voltage requirements.

D. Nameplates: Each switch and/or pilot light shall have individual engraved nameplates describing its function.

PART 3 - EXECUTION

3.1 GENERAL

A. Install motor starters where shown on plans and as indicated on Motor Equipment Schedule.

B. Verify all overload heaters are correctly sized.

C. Coordinate all motor line voltage control wiring for starters with other Trades.

D. Torque all conductor and busbar connections to manufacturer’s recommendations.

END OF SECTION
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PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide service entrance switch, metering, main distribution panelboards, main circuit breakers, feeders and all other equipment required for a complete service entrance and main distribution system.

B. Coordinate installation of new service with utility (Alliant Energy). Owner will pay all utility service related costs.

C. Arrange for the installation of a 800-amp 120/208V, 3-phase, 4-W underground electric service.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

1. 26 0500 Basic Materials and Methods
2. 26 1100 Raceways and Boxes
3. 26 1200 Conductors and Cables
4. 26 1620 Panelboards
5. 26 1700 Motor and Circuit Disconnects
6. 26 4500 Grounding and Bonding

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:


B. References:

1. American National Standards Institute (ANSI): Comply with applicable ANSI Standards pertaining to power/distribution equipment.
2. Institute of Electrical and Electronic Engineers (IEEE): Comply with applicable portion of IEEE Standards pertaining to power/distribution equipment.
3. National Electric Manufacturers Association (NEMA): Comply with applicable portions of NEMA Standards pertaining to power/distribution equipment.
4. Underwriters Laboratories (UL): Electric materials listed and labeled by UL.
5. Insulated Power Cable Engineers Association (IPCEA).
6. Association of Edison Illuminating Companies (AEIC).

1.4 SUBMITTALS

A. Submit in accordance with Division 1 and Section 16 of these Specifications.

B. Submit product data on switchboard, fuses, circuit breakers, panelboards and metering enclosures.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver material with factory installed shipping skids. Package in watertight containers or wrappings.

B. Store material in clean, dry place and protect from weather and construction traffic.

C. Handle material carefully to avoid damage to components, enclosures and finishes.
D. Do not install damaged equipment. Replace and return damaged units to equipment manufacturer.

PART 2 - PRODUCTS

2.1. SEE SECTION 1.2 RELATED DOCUMENTS.

PART 3 - EXECUTION

3.1 GENERAL INSTALLATION

A. Electrical Contractor shall arrange for new service with Electric Utility (Alliant Energy). Owner will pay all service costs. The Electrical Contractor is responsible for proper installation of a complete functioning and approved installation.

B. All work shall be installed according to the Utility (Alliant) Electric Service Rules, NEC and manufacturer’s requirements. Coordinate service installation with the Owner and electric utility providing electric power.

C. Upon completion of installation and utility transformer, energize all circuits at rated voltage and frequency from normal power source. Check phases to demonstrate compatibility with conditions and equipment being served.

D. Electrical Contractor is responsible for maintaining working clearance around all electrical equipment as required by NEC and any local ordinances.

3.2 INSTALLATION BY UTILITY

A. The utility will install, own and maintain the following:

1. Underground primary and secondary cables.
2. Underground service drop.
3. Conduit seals.
4. Socket type KWH meter.
5. Metering cable.
6. Metering transformers

3.3 INSTALLATION BY ELECTRICAL CONTRACTOR

A. The E.C. shall provide and install the following:

1. Pull section where required for termination spark.
2. Metering transformer cabinet; interior location.
3. Main disconnect-fuse or adjustable trip circuit breaker.
4. Main distribution Panelboards
5. Terminal lugs, CU/AL, UL listed.
6. Meter socket.
7. 1” galvanized steel metering conduit.
8. Insulating bushings.
9. Service conduit to transformer; rigid metallic or schedule 40 PVC.
10. Conduit bend, 90 degree, rigid metallic, 4”, 24” radius for primary/secondary service entrance.
11. Concrete transformer pad by the General Contractor, as required and supervised by the Electrical Trade.

3.4 INSPECTION

A. The Electrical Contractor shall make an inspection of the proposed site and shall verify all existing conditions under which the work is to be done with the Electrical Utility.
B. Prior to installation of any electrical service work in conjunction with the Electric Utility, the proposed service work and locations shall be approved by the Owner and A/E.

3.5 CLEANUP AND ADJUST

A. Upon completion of the work, inspect the entire installation. Correct all defective work. Replace all damaged and defective parts with new materials.

B. Upon completion of installation and at such other times as directed, remove all surplus materials, debris, empty cartons, rubbish and legally dispose of same off the site.

3.6 SCHEDULES

A. Coordinate all installation of electric cable with other trades as to alignment, depth, services and all other possible areas of conflict. No additional compensation will be given for damage done to other utilities due to lack of consideration.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Power Distribution Panelboards.
B. Branch Circuit Panelboards.

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 shall govern under work of this section.
B. Specified Elsewhere:
   1. 26 05 00 Electrical General Provisions
   2. 26 45 00 Grounding and Bonding

1.3 QUALITY ASSURANCE
A. Regulatory Requirements:
   1. National Electrical Code, NEC: Comply with NEC/NFPA No. 70/ANSI C1, as applicable to installation of
cabinets, cutout boxes and panelboards.
   2. Underwriters Laboratories, UL:
      a. Comply with specified UL publications pertaining to panelboards, enclosures and panelboard
accessories.
      b. Units listed and labeled by UL.

1.4 REFERENCES
A. National Electrical Manufacturers Association, NEMA:
   1. PB.1: Panelboards.
   2. PB.1.1: Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts
   or Less.

1.5 SUBMITTALS
A. Submit in accordance with Division 1 and Section 16050.
B. Shop Drawings: Submit dimensioned drawings of installed panelboards and enclosures.
   1. Include outline and support point dimensions, voltage, main bus ampacity, integrated
short circuit ampere rating, and circuit breaker arrangement and sizes.

1.6 DELIVERY, STORAGE AND HANDLING
A. Store panelboards and enclosure indoors. Protect from weather.
B. When necessary to store outdoors, elevate well above grade and enclose with durable waterproof wrapping.
C. Handle panelboards and enclosures carefully to prevent breakage, denting and scarring of finish.

1.7 SPARE PARTS
A. Keys: Furnish 2 keys for each panelboard to Owner.
PART 2 - PRODUCTS

2.1 GENERAL

A. Panelboards shall be constructed in accordance with latest NEMA, UL and NEC requirements and shall bear UL label.

B. Panelboard cabinets including boxes and fronts, shall be code gauge galvanized steel. Panel cover shall be finished in manufacturer's standard color. Main lugs shall be top or bottom mounted to coordinate with incoming feeder entrance location.

C. Provide isolated ground bus, where indicated, in addition to normal ground bus. Label isolated ground bus appropriately.

D. All panelboards shall be from one manufacturer.

2.2 ACCEPTABLE MANUFACTURERS

A. Panelboards:
   1. Square D Company.

2.3 PANELBOARD RATINGS

A. UL listed short circuit rating (integral equipment rating):
   1. Service Panels: 65,000 RMS symmetrical amperes minimum or as indicated on panel schedule. Equivalent to Square D I-Line or NQOD, as indicated on the Drawings.
   2. 208Y/120V Branch Circuit Panels: 10,000 RMS symmetrical amperes minimum or as indicated on panel schedule equivalent to Square D Type NQOD.

2.4 POWER DISTRIBUTION PANELBOARDS

A. Panelboards: Circuit breaker type.

B. Enclosure: NEMA Type 1 Minimum cabinet size: 6.5 inches deep; 26 inches wide. Constructed of galvanized code gauge steel.
   1. Cabinet front cover and cabinet shall be Type 4X, 304 stainless steel in wet and damp locations including kitchen, foodservice and therapeutic/pool applications.

C. Provide cabinet front with hinged door with flush lock. Front cover shall be hinged to allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.
   1. Provide metal directory holders with clear plastic covers.

D. Provide panelboards with copper bus (phase buses, bus fingers, etc.), ratings as scheduled on Drawings. Provide ground bars in all panelboards. Neutral and ground bars can be dual rated ALCU9.

E. Minimum System (i.e. individual component) Short Circuit Rating: As shown on the Drawings and as required by short circuit/coordination study provided by the Electrical Contractor.

F. Molded Case Circuit Breakers: Provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole.

G. Circuit breakers shall be bolt-on type with common trip handle for all poles.

2.5 BRANCH CIRCUIT PANELBOARDS

A. Lighting and Appliance Branch Circuit Panelboards: Circuit breaker type.
B. Enclosure: Type 1. Minimum cabinet size: 5-3/4 inches deep; 20 inches wide with 5” minimum gutter space top and bottom. Constructed of galvanized code gauge steel. Panel enclosure (back box) shall be of non-stamped type (without KO's) to avoid concentric break out problem.

C. Cabinet front cover and cabinet shall be Type 4X, 304 stainless steel in wet and damp locations including kitchen, food service and therapeutic/pool applications.

D. Provide flush and surface cabinet fronts as scheduled with concealed trim clamps, concealed hinge and flush cylinder lock all keyed alike. Front cover shall be hinged to allow access to wiring gutters without removal of panel trim. Hinged trim shall be held in place with screw fasteners. Finish in manufacturer's standard gray enamel.

E. Provide metal directory holders with clear plastic covers.

F. Provide panelboards with copper bus (phase buses, bus fingers, etc.), ratings as scheduled on Drawings.
   1. Provide ground bars in all panelboards. Phase, neutral and ground bar terminations can be dual rated ALCU9.
   2. Incoming conductors shall terminate at lug landing pads rated for the panelboard.
   3. Provide compression type lugs to accommodate the conductor shown on drawings.

G. Minimum System (i.e. individual component) Short Circuit Rating: As shown on the Drawings and as required by short circuit/ coordination study provided by the Electrical Contractor.

H. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers. Provide UL Class A ground fault interrupter circuit breakers where shown on Drawings. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.
   1. Do not use tandem circuit breakers.
   2. Circuit breakers shall be bolt-on type with common trip handle for all poles. No handle ties of any sort will be approved.

I. All of the panelboards provided under this section shall be by the same manufacturer.

J. All sub-feed panelboards installed side by side shall utilize same enclosure height.

PART 3 - EXECUTION

3.1 GENERAL

A. Refer to NEMA PB.1.

B. Coordinate installation of panelboards and enclosures with cable and raceway installation work.

C. Provide mounting brackets, busbar drillings and filler pieces for unused spaces.

D. Anchor enclosures firmly to walls and structural surfaces, insuring that they are permanently and mechanically secure.

E. Provide electrical connections within enclosures.

F. Prepare and affix typewritten directory to inside cover of panelboard indicating loads controlled by each circuit.

G. Install panelboards so that no cracks or gaps exist between breakers, breaker cover, panelboard cover and wall (where flush).

H. All wires shall be neatly installed inside the panelboard box.

I. Unused spaces shall be filled with metal filler designed for the purpose by the manufacturer.
J. Stub four (4) empty 3/4" conduits into accessible ceiling space for future wiring requirements.

3.2 INSPECTION

A. Examine area to receive panelboard to assure adequate clearance for panelboard installation.
B. Start work only after unsatisfactory conditions are corrected.

3.3 INSTALLATION

A. Install in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation," and in accordance with recognized industry practices.
B. Flush mount, surface mount, as specified on drawings and schedules.
C. Support panel cabinets independently to structure with no weight bearing on conduits.
D. Install recessed panelboards to allow cover to be drawn tight against wall to provide neat appearance.
E. Install panelboards so top breaker is not higher than 6 ft.-7 in. above floor.
F. Adjacent panel cabinets shall be of same size and mounted in horizontal alignment.
G. Install in each panelboard a typewritten directory accurately indicating rooms and/or equipment being served.
H. Attach nameplates. Nameplates for panels in public areas shall be attached to the inside face of the cover. Nameplates for panels in equipment rooms and other non-public areas shall be attached to the outside face of the cover.
I. EC shall coordinate depth of recess-mounted panels with G.C. and wall construction to ensure panel is fully contained within wall cavity.
J. Recess-mounted panels shall be provided with three 3/4" conduits stubbed into adjacent ceiling space for future circuits.

3.4 FIELD QUALITY CONTROL

A. Balance load among feeder conductors.
B. Unbalance shall not exceed + 7-1/2% of computed average load per phase.
C. Energize each circuit and check for complete and correct function.

3.5 ADJUSTMENT AND CLEANING

A. Adjust doors and operating mechanisms for free mechanical movement.
B. Tighten lugs and bus connections.
C. Clean interior of panelboard.
D. Sand, prime and paint scratched or marred surfaces to match original finish. If other than factory standard color is indicated on Architectural plans, G.C. shall be responsible for painting panel enclosure and/or cover.
E. EC shall install temporary panel covers as necessary during construction to reduce the construction debris within panels.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide fused and unfused disconnect switches for distribution and branch circuits and motors as shown on plans and as required by code.

B. Provide all fuses, circuit breakers, and motor overload elements as described in the specifications and drawings or required by code to protect all equipment.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

1. 26 05 00 Basic Materials and Methods
a. Identification.
b. Spare fuses.
2. 26 15 10 Motors and Motor Wiring
3. 26 18 50 Equipment Connections

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. National Electrical Code, NEC: Comply with NEC/NFPA No. 70, as applicable to construction and installation of electrical motor and circuit disconnect switches.


3. Underwriters Laboratories, UL: Motor and circuit disconnect switches listed and labeled by UL.

1.4 SUBMITTALS

A. Submit in accordance with Division 1 and Section 26 0500.

B. Submit manufacturers data circuit disconnect switches.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver switches individually wrapped in factory-fabricated fiberboard type containers.

B. Store switches in clean, dry space.

C. Protect switches from dirt, fumes, water and physical damage.

D. Handle switches carefully to avoid damage to material components, enclosure and finish.

E. Do not install damaged switches. Remove from project site.

PART 2 - PRODUCTS

2.1 SAFETY SWITCHES

A. Heavy-duty type or as scheduled:
1. Sheet steel enclosed safety switches, size and electrical characteristics indicated, rated at 250 or 600 volts.
2. Quick-make, quick-break constructed so switch blades are visible in "OFF" position with door open.
3. Operating handle as integral part of enclosure base, easily recognizable position, padlockable in "OFF" position.
4. Current carrying parts constructed of high-conductivity copper and silver-tungsten type switch contact.
5. Positive pressure type reinforced fuse clips.
6. Neutral bars shall be provided in all disconnects serving distribution circuits carrying a neutral.
7. Fuses shall be dual element type. Size per NEC code and equipment manufacturer's requirements.
8. Enclosures:
   a. NEMA Type 1.
   b. NEMA Type 3R.

B. Motor and Circuit Disconnects:
   1. Square D Company.

2.2 FUSES

A. All fuses shall be of one manufacturer and shall, where possible, be coordinated per manufacturer's instructions for short circuit currents so that the fuse or circuit breaker closest to the short circuit will trip and clean the fault first.

B. Low voltage fuses shall be Buss KRP-C, JJN, FRN or equal as required. FRN fuses shall only be used for motor loads. No single element fuses will be permitted.

PART 3 - EXECUTION

3.1 DISCONNECT SWITCHES

A. Install disconnect switches as shown on plans and Motor Equipment schedule.

B. Install fuses in all fused disconnects.

C. The Electrical Contractor shall be responsible for maintaining working clearance around all electrical equipment as required by 2008 NEC.

3.2 FUSES

A. Furnish and install all fuses for project.

B. Turn over to Owner 3 spare fuses of each rating 100 amperes and over, 1 box of fuses for each rating less than 100 amperes.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Power and selected control wiring for all equipment including, but not limited to:
   1. HVAC motors and control panels.
   2. Plumbing motors and control panels.

B. Coordinate all equipment requirements with the various contractors and the Owner. Review the complete set of drawings and specifications to determine the extent of wiring, starters, devices, etc., required.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:
   1. Div. 22 Plumbing
   2. Div. 23 HVAC
   3. 26 05 00 Basic Materials and Methods
   4. 26 11 00 Raceways and Boxes
   5. 26 12 00 Low Voltage Conductors and Cables
   6. 26 15 10 Motors and Motor Wiring
   7. 26 15 50 Motor Starters
   8. 26 17 00 Motor and Circuit Disconnects
   9. 26 32 00 Packaged Generator Assembly
   10. 26 36 00 Transfer Switches

PART 2 - PRODUCTS

2.1 SEE 1.2 ABOVE AND DRAWINGS.

PART 3 - EXECUTION

3.1 HVAC AND PLUMBING CONNECTIONS

A. Provide all power wiring including all circuitry carrying electrical energy from panelboard or other source through starters and disconnects to motors or to packaged control panels.

1. Packaged control panels may include disconnects and starters and overcurrent protection. Provide all wiring between packaged control panels and motors.
2. Include starters disconnects and overload protection if not included in packaged control panels.

B. Provide 120 volts circuits to each temperature control panel as indicated on the Drawings.

1. Line voltage wiring requirements for temperature control beyond the requirements shown on the drawings and schedules shall be the responsibility of the Temperature Control Contractor to retain the electrical trade and pay for such work.

C. Unless otherwise specified, all electrical motors and control devices such as aquastats, float and pressure fan powered VAV boxes, switches, electropneumatic switches, solenoid valves and damper motors requiring mechanical connections shall be furnished and installed and wired for low-voltage connections (less than 100volts) by the Contractor supplying the devices or the Temperature Control Contractor, as specified elsewhere.
D. Each motor terminal box shall be connected with a maximum 36" piece of flexible conduit to a fixed junction box. A green wire run through the flexible conduit shall interconnect the motor frame and the rigid conduit system. Use Liquid tight flexible metal conduit for all motor connections.

E. Check for proper rotation of each motor.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Conduit and equipment supports.

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 shall govern work under this section.
B. Specified Elsewhere:
   1. 26 11 00 Raceways and Boxes

1.3 QUALITY ASSURANCE
A. Regulatory Requirements:
   1. National Electrical Code, NEC: Comply with NEC/NFPA No. 70, as applicable to supports.
   2. Underwriters Laboratories, UL: Supports listed and labeled by UL.

PART 2 - PRODUCTS

2.1 MATERIAL
A. Support Channel: Steel, Galvanized, Enameled or other corrosion resistant.
B. Hardware: Corrosion resistant.
C. Minimum sized threaded rod for supports shall be 3/8” for trapezes and single conduits 1-1/4” and larger, and 1/4” for single conduits 1” and smaller.
D. Conduit clamps, straps, supports, etc., shall be steel or malleable iron. One-hole straps shall be heavy duty type. All straps shall have steel or malleable backing plates when rigid steel conduit is installed on the interior or exterior surface of any exterior building wall.

2.2 CONDUIT SUPPORTS
A. Material:
   1. Single Runs:
      a. Galvanized two-hole conduit straps or ring-bolt type hangers with specialty spring clips.
      b. Do not use plumber’s perforated straps.
   2. Multiple Runs: Conduit rack with 25% spare capacity.
   3. Vertical Runs: Channel support with conduit fittings.
      a. 25-ft intervals.
B. Anchor Methods:
   1. Hollow Masonry: Toggle bolts or spike type expansion anchors.
   2. Solid Masonry: Lead expansion anchors or preset inserts.
   3. Metal Surfaces: Machine screws, bolts or welded studs.
   5. Concrete Surfaces: Self-drilling anchors or power driven studs.
C. **Light Fixtures:**
   1. Provide grid troffer clips in accordance with NEC 410-16.

D. **Mounting Racks and Supports:**
   1. Provide rack and supports of galvanized or painted steel channel sections with bolted or welded fittings.
   2. Provide exterior treated 3/4" plywood mounting surface with gray paint finish on both sides and edges.

**PART 3 - EXECUTION**

3.1 **GENERAL**

A. Maintain headroom, neat mechanical appearance and to support equipment loads.

B. Suspend, support from and attach only to the structural elements at intervals required by code, with threaded rod, channels, "stand-off" and other clips and NECA approved devices.

C. To the fullest extent possible, group several conduits together and run parallel, supporting with rod and channel.

3.2 **INSTALLATION**

A. Fasten hanger rods, conduit clamps, outlet, junction and pull boxes to building structure using pre-cast insert system, preset inserts, beam clamps, expansion anchors, or spring steel clips (interior metal stud walls only).
   1. Do not use "stand-off" clips for attachment to walls and partitions.
   2. Install raceways tight to walls.

B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchors on concrete surfaces; sheet metal screws in sheet metal studs and wood screws in wood construction. If nail-in anchors are used, they must be removable type anchors.

C. Do not fasten supports to piping, ductwork, mechanical equipment, cable tray or conduit. Do not fasten to suspended ceiling grid system.

D. Fabricate supports from galvanized structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

E. In wet locations, mechanical rooms and electrical rooms install free-standing electrical equipment on 3.5 inch (89 mm) concrete pads.

F. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch (25 mm) off wall (7/8” Uni-strut or ¾” painted, fire-retardant plywood is acceptable).

G. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

H. Furnish and install all supports as required to fasten all electrical components required for the project, including free standing supports required for those items remotely mounted from the building structure, catwalks, walkways etc.

**END OF SECTION**
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. It is the intent of this specification to secure an engine-driven generator assembly that has been prototype tested, factory built, production-tested, and site-tested together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein.

B. The power system shall be furnished by a single manufacturer who shall be responsible for the design, coordination, and testing of the complete system. The entire system shall be installed as shown on the plans, drawings, and specifications herein.

C. The equipment shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.

D. The equipment shall be produced by a manufacturer who is ISO 9001 certified for the design, development, production and service of its complete product line.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 and Section 16400 shall govern work under this section.

B. Section 26 36 00 - Transfer Switches.

1.3 CODES AND STANDARDS

A. The generator set shall conform to the requirements of the following codes and standards:

1. CSA C22.2, No. 14 – M91 Industrial Control Equipment.
3. EN 55011, Limits and Methods of Measurement of Radio Interference Characteristics of Industrial, Scientific and Medical Equipment.
4. IEC 8528 part 4. Control Systems for Generator Sets
   IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions.
5. IEEE 446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
8. NFPA 70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
10. NFPA 110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.
11. UL 2200. The genset shall be listed to UL 2200 or submit to an independent third party certification process to verify compliance as installed

1.4 PERMITS

A. The Contractor shall be responsible for obtaining all necessary permits for the complete installation of the generator fuel system and related equipment. The contractor shall arrange to have a certified tank installer supervise and certify the fuel system installation.

1.5 SUBMITTAL
A. Submittal shall include specification sheets showing all standard and optional accessories to be supplied, schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set, the transfer switch and any related remote annunciator panels.

B. Submit tail pipe back pressure calculations for extended tail pipe routing proposed.

C. Submit manufacturer's installation instructions.

1.6 APPROVED MANUFACTURERS

A. Kohler

B. Cummins/ONAN

C. Generac.

1.7 OPERATION AND MAINTENANCE DATA

A. All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

1.8 QUALITY ASSURANCE

A. Manufacturer: Company specializing in packaged engine generator systems with minimum ten years documented experience. Packaged generator assembly shall meet UL 2200 requirements.

B. Supplier: Authorized distributor of engine generator manufacturer with service facilities within 100 miles of project site.

C. The generator set manufacturer and its distributor shall maintain a 24-hour parts and service organization. This organization shall be regularly engaged in a maintenance contract program to perform preventive maintenance and service on equipment similar to that specified.

1. A service agreement shall be available and shall include system operation under simulated operating conditions, adjustment to the generator, transfer switch, and switchgear controls as required, and certification in the owner's maintenance log of repairs made and proper functioning of all systems.

1.9 TESTING

A. PROTOTYPE TESTING: To assure that the equipment has been designed and built to the highest reliability and quality standards, the manufacturer shall be responsible for design prototype tests as described herein: Components of the emergency system, such as the engine/generator set, transfer switch, and accessories shall not be subjected to prototype tests since the tests are potentially damaging. Rather, similar design prototypes which will not be sold, shall be used for these tests. Prototype test programs shall include the requirements of NFPA-110 and the following:

1. Maximum power (kw).
2. Maximum starting (kva) at 35% instantaneous voltage dip.
4. Governor speed regulation under steady-state and transient conditions.
5. Voltage regulation and generator transient response.
6. Fuel consumption at no load, 1/4, 1/2, 3/4, and full load.
7. Harmonic analysis, voltage waveform deviation, and telephone influence factor.
9. Alternator cooling air flow.
10. Torsional analysis testing to verify that the generator set is free of harmful torsional stresses.
11. Endurance testing.
B. PRODUCTION TESTING: Each generator set shall be tested under varying loads with guards and exhaust system in place. Tests shall include:

2. Transient and steady—state governing.
3. Safety shutdown device testing.
4. Voltage regulation.
5. Rated Power @ 0.8 PF

Upon request, arrangements to either witness this test will be made, or a certified test record will be sent prior to shipment.

C. SITE TESTING: An installation check, start-up, and building load test shall be performed by the manufacturer's local representative. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:

1. Fuel, lubricating oil, and antifreeze shall be checked for conformity to the manufacturer's recommendations, under the environmental conditions present and expected.
2. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. These shall include: block heaters, battery charger, generator strip heaters, remote annunciator, etc.
3. Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and frequency, and phase rotation.
4. Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper system coordination. Engine coolant temperature, oil pressure, and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the test.

1.10 WARRANTY

A. The generator set shall include a standard one year warranty to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from date of startup.

1. Optional warranties shall be available upon request.

PART 2 - PRODUCTS

2.1 PACKAGED GENERATOR ASSEMBLY

A. EQUIPMENT:

1. The generator set shall be equal to a Kohler model 100RZDG with a 4R12X alternator. The generator set shall provide 100kW/125 kVA when operating at 120/208 volts, 60 Hz, 0.8 power factor. The generator set shall be capable of a Standby 130°C rating while operating in an ambient condition of less than or equal to 77° F and a maximum elevation of 866 feet above sea level.
2. Motor starting performance and voltage dip determinations shall be based on the complete generator set. The generator set shall be capable of supplying 385 LRKVA for starting motor loads with a maximum instantaneous voltage dip of 35%, as measured by a digital RMS transient recorder in accordance with IEEE standard 115.
3. Motor starting performance and voltage dip determination that does not account for all components affecting total voltage dip i.e. engine, alternator, voltage regulator and governor will not be acceptable. As such, the generator set shall be prototype tested to optimize and determine performance as a generator set system.
4. Vibration isolators shall be provided between the engine-generator and heavy-duty steel base.

B. ENGINE: The 350 cubic-inch-displacement engine shall deliver a minimum of 155 hp at a governed speed of 1800 rpm. The engine shall be equipped with the following:
1. Electronic isochronous governor capable of 0.25% steady-state frequency regulation.
2. 12 Volt positive engagement solenoid shift-starting motor.
3. 130-Ampere minimum automatic battery charging alternator with solid-state voltage regulation.
4. Positive displacement, full pressure lubrication oil pump, cartridge oil filters, dipstick, and oil drain.
5. Dry-type replaceable air cleaner elements for normal applications.
6. Engine-driven or electric fuel-transfer pump including fuel filter and electric solenoid fuel shutoff valve capable of lifting fuel.
7. Natural aspirated, air-cooled engine shall be fueled by natural gas.
   The engine shall have a minimum of 8 cylinders and be liquid-cooled by unit mounted radiator 122°F/50°C.
8. The engine shall be EPA certified from the factory.

C. GENERATOR:

1. The alternator shall be salient-pole, brushless, 2/3-pitch, 12 lead, self-ventilated with drip-proof construction and amortisseur rotor windings and skewed for smooth voltage waveform.
   a. The ratings shall meet the NEMA standard (MG1-32.40) temperature rise limits. The insulation shall be class H per UL1446 and the varnish shall be a fungus resistant epoxy.
   b. Temperature rise of the rotor and stator shall be limited to Standby 130°C.
   c. The excitation system shall be of brushless construction controlled by a solid-state voltage regulator capable of maintaining voltage within ±2.0% at any constant load from 0% to 100% of rating.
   d. The AVR shall be capable of proper operation under severe nonlinear loads and provide individual adjustments for voltage range, stability and volts-per-hertz operations. The AVR shall be protected from the environment by conformal coating.
   e. The waveform harmonic distortion shall not exceed 5% total RMS measured line-to-line at full rated load. The TIF factor shall not exceed 50.
2. The alternator shall have a single maintenance-free bearing, designed for 40,000 hour B10 life. The alternator shall be directly connected to the flywheel housing with a semi-flexible coupling between the rotor and the flywheel.
3. The generator shall be inherently capable of sustaining at least 250% of rated current for at least 10 seconds under a 3-phase symmetrical short circuit without the addition of separate current-support devices.

2.2 CONTROLLER

A. The generator set controller shall meet NFPA 110 Level 1 requirements (1996 version) and shall include an integral alarm horn as required by NFPA.

1. The controller shall meet NFPA 99 and NEC requirements.
2. The controller shall be UL 508 listed.

B. Applicability

1. The controller shall be standard on a the generator set.
2. The controller shall support 12-volt starting systems.
3. The controller's environmental specification shall be: -40°C to 70°C operating temperature range and 5-95% humidity, non-condensing.
4. The controller shall mount on the generator or remotely within 40 feet with viewable access.

C. Hardware Requirements

1. Control Panel shall include:
   a. The control shall have a run-off/reset-auto three-position selector switch.
   b. Controller-mounted, latch-type emergency stop pushbutton.
   d. Display with two lines of 20-alphanumeric characters, viewable in all light conditions.
Sixteen position snap action sealed keypad for menu selection and data entry.

For ease of use, an operating guide shall be printed on the controller faceplate.

An audible alarm with alarm silence capability.

Panel lights shall be supplied as standard.

D. Control Functional Requirements

1. Field-programmable time delay for engine start. Adjustment range 0-5 minutes in 1 second increments.
2. Field-programmable time delay engine cooldown. Adjustment range 0-10 minutes in 1 second increments.
3. Capability to start and run at user-adjustable idle speed during warmup for a selectable time period (0-10 minutes), until engine reaches preprogrammed temperature, or as supported by ECM-equipped engine.
4. The idle function including engine cooldown at idle speed.
5. Real-time clock and calendar for time stamping of events.
6. Output with adjustable timer for an ether injection starting system. Adjustment range, 0-10 seconds.
7. Output for shedding of loads if the generator set reaches a user programmable percentage of its kW rating. Load shed shall also be enabled if the generator set output frequency falls below 59 Hz.
8. Programmable cyclic cranking that allows up to six crank cycles and up to 35 seconds of crank time per crank cycle.
9. The capability to reduce controller current battery draw, for applications where no continuous battery charging is available. The controller vacuum fluorescent display should turn off automatically after the controller is inactive for 5 minutes.
10. Control logic with alternator protection for overload and short circuit matched to each individual alternator and duty cycle.
11. Control logic with RMS digital voltage regulation. A separate voltage regulator is not acceptable. The digital voltage regulator shall be applicable to single- or three-phase systems.
12. The capability to exercise the generator set by programming a running time into the controller. This feature shall also be programmable through the PC software.
13. Control function shall include output voltage adjustment.
14. Battle switch function selection to override normal fault shutdowns, except emergency stop and overspeed shutdown.
15. The control shall detect the following conditions and display on control panel:
   a. Customer programmed digital auxiliary input ON (any of the 21 inputs available).
   b. Customer programmed analog auxiliary input out of bounds (any of 7 inputs for ECM equipped engines and 5 inputs for non ECM engines).
   c. Emergency stop.
   d. High coolant temperature.
   e. High oil temperature.
   f. Controller internal fault.
   g. Locked rotor - fail to rotate.
   h. Low coolant level.
   i. Low oil pressure.
   j. Master switch error.
   k. NFPA common alarm.
   l. Overcrank.
   m. Overspeed with user-adjustable level, range 60-70 Hz.
   n. Overvoltage with user adjustable level, range 105% to 135%.
   o. Overfrequency with user adjustable level, range 102% to 140%.
   p. Underfrequency with user adjustable level, range 80% to 90%.
   q. Undervoltage with user adjustable level, range 70% to 95%.
   r. Coolant temperature signal loss.
   s. Oil pressure gauge signal loss.

Conditions resulting in generator warning (generator will continue to operate):
   a. Battery charger failure.
   b. Customer programmed digital auxiliary input ON (any of the 21 inputs available).
   c. Customer programmed analog auxiliary input out of bounds (any of 7 inputs for ECM equipped engines and 5 inputs for non ECM engines).
   d. Power system supplying load.
e. Ground fault detected - detection by others.
f. High battery voltage - Level shall be user adjustable.
g. Range 29-33 volts for 24-volt systems.
h. High coolant temperature.
i. Load shed.
j. Loss of AC sensing.
k. Underfrequency.
l. Low battery voltage - level shall be user adjustable, range 20-25 volts for 24-volt systems.
m. Low coolant temperature.
n. Low fuel level or pressure.
o. Low oil pressure.
p. NFPA common alarms.
q. Overcurrent.
r. Speed sensor fault.
s. Weak battery.
t. Alternator protection activated.

E. Control Monitoring Requirements

1. All monitored functions must be viewable on the control panel display.

2. The following generator set functions shall be monitored:
   a. All output voltages - single phase, three phase, line to line, and line to neutral, 0.25% accuracy.
   b. All single phase and three phase currents, 0.25% accuracy.
   c. Output frequency, 0.25% accuracy.
   d. Power factor by phase with leading/lagging indication.
   e. Total instantaneous kilowatt loading and kilowatts per phase, 0.5% accuracy.
   f. kVARS total and per phase, 0.5% accuracy.
   g. kVA total and per phase, 0.5% accuracy.
   h. kW hours.
   i. A display of percent generator set duty level (actual kW loading divided by the kW rating).

3. Engine parameters listed below shall be monitored: (*available with ECM equipped engines)
   a. Coolant temperature both in English and metric units.
   b. Oil pressure in English and metric units.
   c. Battery voltage.
   d. RPM.
   e. Lube oil temperature.*
   f. Lube oil level.*
   g. Crankcase pressure.*
   h. Coolant level.*
   i. Coolant pressure.*
   j. Fuel pressure.*
   k. Fuel temperature.
   l. Fuel rate.
   m. Fuel used during the last run.
   n. Ambient temperature.

4. Operational records shall be stored in the control beginning at system startup.
   a. Run time hours.
   b. Run time loaded hours.
   c. Run time unloaded hours.
   d. Number of starts.
   e. Factory test date.
   f. Last run data including date, duration, and whether loaded or unloaded.
   g. Run time kilowatt hours.
5. The following operational records shall be a resettable for maintenance purposes:
   a. Run time hours.
   b. Run time loaded hours.
   c. Run time unloaded hours.
   d. Run time kilowatt hours.
   e. Days of operation.
   f. Number of starts.
   g. Start date after reset.

6. The controller shall store the last one hundred generator set system events with date and time of the event.

7. For maintenance and service purposes, the controller shall store and display on demand the following information:
   a. Manufacturer's model and serial number.
   b. Battery voltage.
   c. Generator set kilowatt rating.
   d. Rated current.
   e. System voltage.
   f. System frequency.
   g. Number of phases.

F. Inputs and Outputs

1. Inputs:
   a. There shall be 21 dry contact inputs that can be user-configured to shut down the generator set or provide a warning.
   b. There shall be 7 user-programmable analog inputs for ECM-equipped engines (5 for non-ECM engines) for monitoring and control.
   c. Each analog input can accept 0-5 volt analog signals
   d. Resolution shall be 1:10,000
   e. Each input shall include range settings for 2 warnings and 2 shutdowns.
   f. All values shall be on the control panel display.
   g. Shall be user-assigned.
   h. Additional standard inputs required:
      • Input for an external ground fault detector. Digital display shall show "ground fault" upon detection of a ground fault.
      • Reset of system faults.
      • Remote two-wire start.
      • Remote emergency stop.
   i. Idle mode enable.

2. Outputs:
   a. All NFPA 110 Level 1 outputs shall be available.
   b. Thirty outputs shall be available for interfacing to other equipment:
      • All outputs shall be user-configurable from a list of 25 functions and faults.
      • These outputs shall drive optional dry contacts.
   c. A programmable user-defined common fault output with over 40 selections shall be available.

G. Communications

1. If the generator set engine is equipped with an ECM (engine control module), the controller shall communicate with the ECM for control, monitoring, diagnosis, and meet SAE J1939 standards.
2. Industry standard Modbus communication shall be available.
3. A Modbus master shall able to monitor and alter parameters, and start or stop a generator.
4. The controller shall have the capability to communicate to a personal computer (IBM or compatible) running Windows '9X or Windows NT.
5. Communications shall be available for serial, CAN, and Ethernet bus networks.
6. A variety of connections shall be available based on requirements:
   a. A single control connection to a PC.
   b. Multiple controls on an intranet network connected to a PC.
   c. A single control connection to a PC via phone line.
   d. Multiple controls to a PC via phone line.
7. Generator and transfer switch controls shall be equipped with communications modules capable of connecting to the same communication network.
8. The capability to connect up to 128 controls (any combination of generator sets and transfer switches) on a single network shall be supported.
9. Cabling shall not be limited to the controller location.
10. Network shall be self-powered.

2.3 ACCESSORIES

A. Critical Silencer. The engine exhaust silencer shall be temperature and rust resistant, and rated for critical applications. The silencer will reduce total engine exhaust noise by 25-35 db(A).

B. Circuit Breaker #1. The generator shall come with a primary, factory installed, 80% rated line circuit breaker of 400 amperes that is UL2200 listed. Line circuit breakers shall be sized for the rated ampacity of the genset and 42K AIC rating. Load side lugs shall be provided from the factory. The line circuit breaker shall include auxiliary contacts, shunt trip, undervoltage trip, alarm switch, and overcurrent switch functionality. Load side breaker connections made at the factory shall be separated from field connections.

C. Block Heater. The block heater shall be thermostatically controlled and sized to maintain manufacturers recommended engine coolant temperature to meet the start-up requirements of NFPA 99 and NFPA 110, Level 1.

D. A sound attenuated weather housing shall be provided. The housing shall be constructed of 18 gauge pre-painted galvanized steel to resist corrosion. The maximum sound level shall not exceed 71 dba at 7 meters (23 feet).

E. Battery rack, and battery cables, capable of holding the manufacturer's recommended batteries, shall be supplied.
   1. 12-volt lead-antimony battery(ies) capable of delivering the manufacturer's recommended minimum cold-cranking Amps required at 0oF, per SAE Standard J-537, shall be supplied.
   2. 6-Ampere automatic float and equalize battery charger with +/- 1% constant voltage regulation from no load to full load over +/-10% AC input line variation, current limited during engine cranking and short circuit conditions, temperature compensated for ambient temperatures from -40oC to +60oC, 5% accurate voltmeter and ammeter, fused, reverse polarity and transient protected.
   3. Battery heater.

F. Rodent guard.

PART 3 - EXECUTION

3.1 GENERAL

A. Install in accordance with manufacturer's instructions.

B. Generator set shall be anchored to the floor or concrete pad.

C. Contractor shall provide all required fuel during testing and a full tank of fuel at the time of Substantial Completion of the project.

3.2 INSTALLATION

A. The equipment shall be installed as shown on the plans, in accordance with the manufacturer's recommendations and all applicable codes.
B. Site Tests: An installation check, start-up, and building load test shall be performed by the manufacturer's local representative. The engineer, regular operators, and the maintenance staff shall be notified of the time and date of the site test. The tests shall include:

1. Fuel, lubricating oil, and antifreeze (liquid cooled models) shall be checked for conformity to the manufacturer's recommendations under the environmental conditions present and expected.

2. Accessories that normally function while the set is standing by shall be checked prior to cranking the engine. This shall include: Engine heaters, battery charger, generator strip heaters, remote annunciator, etc.

3. Start-up under test mode to check for exhaust leaks, path of exhaust gases outside the building, cooling air flow, movement during starting and stopping, vibration during running, normal and emergency line-to-line voltage and phase rotation.

4. Automatic start-up by means of simulated power outage to test remote-automatic starting, transfer of the load, and automatic shutdown. Prior to this test, all transfer switch timers shall be adjusted for proper systems coordination. Engine temperature, oil pressure and battery charge level along with generator voltage, amperes, and frequency shall be monitored throughout the test.

5. Equipment: The supplier of the generator system shall assume system integrity and shall supervise the installation of the unit and support equipment.

6. In the event of a malfunction of either the generator or any support equipment, the generator supplier shall have the responsibility of rectifying the malfunctioning item or items and get the equipment in operation in the shortest possible period of time.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. TRANSFER SWITCH: It is the intent of this specification to secure a transfer switch that has been prototype tested, factory built, production tested, and site tested, together with all accessories necessary for a complete installation as shown on the plans and drawings and specified herein. A transfer switch with number of poles, voltage and current ratings as shown on the plans and specified herein shall be provided. Each ATS shall consist of a power transfer switch unit and a control module interconnected to provide complete automatic operation.

B. Provide one(1) open-transition type, automatic transfer switches with 3-poles, rated at 400-amps, 208-volt, 60Hz, 3-phase and 4-wire configuration with fully rated solid neutral lug assembly.
   1. Design basis: Kohler model KSS automatic transfer switch.

C. All transfer switches and controllers shall be the products of the same manufacturer.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 and Section 26 0500 shall govern work under this section.

1.3 CODES AND STANDARDS

A. The automatic transfer switches and controls shall conform to the requirements of:
   1. UL 1008 - Standard for Transfer Switch Equipment
   2. IEC 947-6-1 Low-voltage Switchgear and Control gear; Multifunction equipment; Automatic Transfer Switching Equipment
   3. NFPA 70 - National Electrical Code
   4. NFPA 99 - Essential Electrical Systems for Health Care Facilities
   5. NFPA 110 - Emergency and Standby Power Systems
   7. NEMA Standard ICS10-1993 (formerly ICS2-447) - AC Automatic Transfer Switches
   8. UL 508 Industrial Control Equipment
   9. CSA C22.2 No. 178 certification

1.4 SUBMITTAL

A. Submittal shall include specification sheets showing all standard and optional accessories to be supplied, schematic wiring diagrams, dimension drawings, and interconnection diagrams identifying by terminal number each required interconnection between the generator set and the transfer switch.

1.5 APPROVED MANUFACTURERS

A. Kohler KSS-DCTA series.

B. Cummins/ONAN.

C. ASCO.

D. Generac.
1.6 QUALITY ASSURANCE

A. Service Representation: The manufacturer shall maintain a national service organization of employing personnel located throughout the contiguous United States. The service center's personnel must be factory trained and must be on call 24 hours a day, 365 days a year.

B. The manufacturer shall maintain records of each switch, by serial number, for a minimum of 20 years.

1.7 TESTS AND CERTIFICATION

A. Upon request, the manufacturer shall provide a notarized letter certifying compliance with all of the requirements of this specification including compliance with the above codes and standards. The certification shall identify, by serial number(s), the equipment involved. No exceptions to the specifications, other than those stipulated at the time of the submittal, shall be included in the certification.

B. The ATS manufacturer shall be certified to ISO 9001 International Quality Standard and the manufacturer shall have third party certification verifying quality assurance in design/development, production, and installation and servicing in accordance with ISO 9001.

1.8 WARRANTY

A. The transfer switches shall include a standard one year warranty to guarantee against defective material and workmanship in accordance with the manufacturer's published warranty from date of startup.

PART 2 - PRODUCTS

2.1 MECHANICALLY-HELD OPEN-TRANSITION TRANSFER SWITCH

A. The transfer switch shall be electrically operated and mechanically held with double throw construction, and operated by a momentarily energized solenoid-driven mechanism. Main operators shall include overcurrent disconnect devices; linear motors or gears shall not be acceptable.

B. All transfer switch sizes shall use only one type of main operator for ease of maintenance and commonality of parts.

C. The switch shall be positively locked and unaffected by momentary outages, so that contact pressure is maintained at a constant value and contact temperature rise is minimized for maximum reliability and operating life.

D. All main contacts shall be silver composition. Switches rated 600 amperes and above shall have segmented, blow-on construction for high withstand and close-on capability and be protected by separate arcing contacts.

E. Inspection of all contacts shall be possible from the front of the switch without disassembly of operating linkages and without disconnection of power conductors. Switches rated 600 amps and higher shall have front removable and replaceable contacts. All stationary and moveable contacts shall be replaceable without removing power conductors and/or bus bars.

F. Designs utilizing components of molded-case circuit breakers, contactors, or parts thereof, which are not intended for continuous duty, repetitive switching or transfer between two active power sources, are not acceptable.

G. Where neutral conductors are to be solidly connected as shown on the plans, a neutral conductor plate with fully rated AL-CU pressure connectors shall be provided.

   1. Three-pole transfer switches shall contain a factory installed fully rated solid neutral lug assembly.

H. A factory installed equipment ground bar shall be provided in each switch enclosure.
2.2 ENCLOSURE

A. The ATS shall be furnished in a NEMA 1 (A) enclosure.

B. All standard door mounted switches and long life super bright type indicating LEDs described in section 3 shall be integrated into a flush-mounted, interface membrane or equivalent in the enclosure door for easy viewing & replacement. The panel shall be capable of having manual locking feature to allow the user to lockout all membrane mounted control switches to prevent unauthorized tampering.

C. This cover shall be mounted with hinges and have a latch that may be padlocked. The membrane panel shall be suitable for mounting by others when furnished on open type units.

2.3 CONTROLLER DISPLAY AND KEYPAD

A. A four line, 20 character LCD display and dynamic 4 button keypad shall be an integral part of the controller for viewing all available data and setting desired operational parameters. Operational parameters shall also be available for viewing and limited control through the communications interface port. The following parameters shall only be adjustable via a password protected programming on the controller (dip switches shall not be acceptable):

- Nominal line voltage and frequency
- Single or three phase sensing
- Operating parameter protection
- Transfer operating mode configuration (Open transition, Closed transition, or Delayed transition)

B. All instructions and controller settings shall be easily accessible, readable and accomplished without the use of codes, calculations, or instruction manuals.

2.4 VOLTAGE, FREQUENCY AND PHASE ROTATION SENSING

A. Voltage (all phases) and frequency on both the normal and emergency sources shall be continuously monitored, with the following pickup, dropout, and trip setting capabilities (values shown as % of nominal unless otherwise specified):

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Dropout/Trip</th>
<th>Pickup/Reset</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under voltage</td>
<td>75 to 98%</td>
<td>85 to 100%</td>
</tr>
<tr>
<td>Over voltage</td>
<td>105 to 135%</td>
<td>95 to 100% of trip</td>
</tr>
<tr>
<td>Under frequency</td>
<td>85 to 99%</td>
<td>95 to 99%</td>
</tr>
<tr>
<td>Over frequency</td>
<td>105 to 120%</td>
<td>101 to 105%</td>
</tr>
<tr>
<td>Voltage unbalance</td>
<td>5 to 20%</td>
<td>3% to 18%</td>
</tr>
</tbody>
</table>

B. Repetitive accuracy of all settings shall be within ± 0.5% over an operating temperature range of -20°C to 70°C.

C. An adjustable dropout time for transient voltage and frequency excursions shall be provided. The time delays shall be 0.1 to 9.9 seconds for voltage and .1 to 15 seconds for frequency.

D. Voltage and frequency settings shall be field adjustable in 1% increments either locally with the display and keypad or remotely via the communications interface port.

E. The controller shall be capable of sensing the phase rotation of both the normal and emergency sources. The source shall be considered unacceptable if the phase rotation is not the preferred rotation selected (ABC or BAC). Unacceptable phase rotation shall be indicated on the LCD; the service required LED and the annunciation through communication protocol and dry contacts. In addition, the phase rotation sensing shall be capable of being defeated, if required.

F. The controller shall be capable of detecting a single phasing condition of a source, even though a voltage may be regenerated by the load. This condition shall be considered a failed source.
G. Source status screens shall be provided for both normal & emergency to provide digital readout of voltage on all 3 phases (phase to phase and phase to neutral), frequency, and phase rotation.

2.5 TIME DELAYS

A. An adjustable time delay of 0 to 10 seconds shall be provided to override momentary normal source outages and delay all transfer and engine starting signals.Capability shall be provided to extend this time delay to 60 minutes by providing an external 12 or 24 VDC power supply.

B. A time delay shall be provided on transfer to the emergency source, adjustable from 0 to 60 minutes, for controlled timing of transfer of loads to emergency.

C. A time delay shall be provided on re-transfer to normal. The time delays shall be adjustable from 0 to 60 minutes. Time delay shall be automatically bypassed if the emergency source fails and the normal source is acceptable.

D. A time delay shall be provided on shut down of engine generator for cool down, adjustable from 0 to 60 minutes.

E. A time delay activated output signal shall also be provided to drive external relay(s) for selective load disconnect control. The controller shall be capable of controlling a maximum of 9 individual output time delays to step loads on after a transfer occurs. Each output may be individually programmed for their own time delay of up to 60 minutes. Each sequence shall be independently programmed for transferring from normal to emergency and transferring from emergency to normal.

F. The controller shall also include the following built-in time delays for the following operations:
   1. 0 to 60 minute time delay on failure to acquire the acceptable electrical parameters from the emergency source.
   2. 0 to 60 minute time delay for a failure to synchronize on an in-phase operation.
   3. 60 minute time delay for the load disconnect position for delayed transition operation.

G. All time delays shall be adjustable in 1 second increments.

H. All time delays shall be adjustable by using the display and keypad or with a remote device connected to the communications interface port through a security-password system.

I. All time delays shall be adjustable by using the display and keypad or with a remote device connected to the communications interface port through a security-password system.

J. Each time delay shall be identified and a dynamic countdown shall be shown on the display.

2.6 ADDITIONAL FEATURES

A. The controller shall have 3 levels of security. Level 1 shall allow monitoring of settings and parameters only. The Level 1 shall be capable of restricted with the use of a lockable cover. Level 2 shall allow test functions to be performed and Level 3 shall allow setting of all parameters.

B. Membrane-type switches shall be provided for the test functions and be maintained until the end test function is activated. The test function shall be allowed through password security. It shall be possible to defeat the password requirement by way of a circuit board mounted dip switch setting. The test function shall be load, no load or auto test. The auto test function shall request an elapsed time for test. At the completion of this time delay the test shall be automatically ended and a retransfer sequence shall commence. All loaded tests shall be immediately ended and retransfer shall occur if the emergency source fails and the normal source is acceptable.

C. A SPDT contact, rated 5 amps at 30 VDC, shall be provided for a low-voltage engine start signal. The start signal shall prevent dry cranking of the engine by requiring the generator set to reach proper output, and run for the duration of the cool down setting, regardless of whether the normal source restores before the load is transferred.

D. Auxiliary contacts, rated 10 amps, 250 VAC shall be provided consisting of two contacts, closed when the ATS is connected to the normal source and two contacts closed, when the ATS is connected to the emergency source.
E. LED indicating lights shall be provided; one to indicate when the ATS is connected to the normal source (green) and one to indicate when the ATS is connected to the emergency source (red).

F. LED indicating lights shall be provided and energized by controller outputs. The lights shall provide true source availability of the normal (green) and emergency sources (red), as determined by the voltage, frequency and phase rotation sensing trip and reset settings for each source.

G. A membrane switch shall be provided on the membrane panel to test all indicating lights and display when pressed.

H. Provide the ability to select “commit/no commit to transfer” to determine whether the load should be transferred to the emergency generator if the normal source restores before the generator is ready to accept the load.

I. Terminals shall be provided for a remote contact which opens to signal the ATS to transfer to emergency and for remote contacts which closes to inhibit transfer to emergency and/or retransfer to normal. Both of these inhibit signals can be activated through the keypad or the communications interface port. A “not-in-auto” LED shall indicate anytime the controller is inhibiting transfer from occurring.

J. An in-phase monitor shall be a standard feature in the controller. The monitor shall control transfer so that motor load inrush currents do not exceed normal starting currents, and shall not require external control of power sources. The in-phase monitor shall be specifically designed for and be the product of the ATS manufacturer. The in-phase monitor shall be capable of being enabled or disabled for the user interface.

K. Engine Exerciser - The controller shall provide an internal engine exerciser. The engine exerciser shall allow the user to program up to 21 different exercise routines based on a calendar mode. For each routine, the user shall be able to:
   1. Enable or disable the routine.
   2. Enable or disable transfer of the load during routine.
   3. Set the start time, time of day, day of week, week of month (1st, 2nd, 3rd, 4th, alternate or every).
   4. Set the duration of the run.
   5. At the end of the specified loaded exercise duration the switch shall transfer the load back to normal and run the generator for the specified cool down period. All loaded exercises shall be immediately ended and retransfer shall occur if the standby source fails. The next exercise period shall be displayed on the main screen with the type of exercise, time and date. The type of exercise and the time remaining shall be displayed when the exercise is active. It shall be possible of ending the exercise event with a single button push.

L. Date and time - The date shall automatically adjust for leap year and the time shall have the capability of automatically adjusting for daylight saving and standard times.

M. System Status - The controller shall have a default display the following on:
   1. System status
   2. Date, time and type of the next exercise event
   3. Average voltage of the preferred and standby sources

Scrolling through the displays shall indicate the following:
   1. Line to line and line to neutral voltages for both sources
   2. Frequency of each source
   3. Load current for each phase
   4. Single or three phase operation
   5. Type of transition
   6. Preferred source
   7. Commit or no commit modes of operation
   8. Source/source mode (Utility/Gen; Gen/Gen; Utility/Utility)
   9. In phase monitor enable/disable
   10. Phase rotation
   11. Date and time
Controllers that require multiple screens to determine system status or display "coded" system status messages, which must be explained by references in the operator’s manual, are not permissible.

Self Diagnostics - The controller shall contain a diagnostic screen for the purpose of detecting system errors. This screen shall provide information on the status input signals to the controller which may be preventing load transfer commands from being completed.

Communications Interface - The controller shall be capable of interfacing, through a standard communications with a network of transfer switches and generators. It shall be able to be connected via an RS-485 serial communication (up to 4000 ft. direct connect or multi-drop configuration), an Ethernet connectivity (over standard 10baseT Ethernet networks utilizing a RJ-45 port or remotely utilizing a dial-up modem). This module shall allow for seamless integration of existing or new communication transfer devices and generators. Monitoring software shall allow for the viewing, control and setup of parameters of the genset and transfer switch network through a standard personal computer utilizing current Microsoft operating systems. Separate and specific transfer switch software interfaces shall not be acceptable.

The transfer switch shall also be able to interface to 3rd party applications using Modbus RTU and Modbus TCP/IP open standard protocols utilizing Modbus register maps. Proprietary protocols shall not be acceptable.

The controller shall contain a USB port for downloading the controller’s parameters and settings; exercise event schedules; maintenance records and event history. The file designator shall be the unique serial number of the transfer switch.

Data Logging - The controller shall have the ability to log data and to maintain the last 2000 events, even in the event of total power loss. The following events shall be time and date stamped and maintained in a non-volatile memory. The controller shall be able to display up to the last 99 events. The remaining events shall be downloadable to be displayed on a computer.

1. Event Logging
   Data, date and time indication of any event.
2. Statistical Data
   Total number of transfers.*
   Total number of fail to transfers.*
   Total number of transfers due to preferred source failure.*
   Total number of minutes of operation.*
   Total number of minutes in the standby source.*
   Total number of minutes not in the preferred source*
   Normal to emergency transfer time
   Emergency to normal transfer time
   System start date
   Last maintenance date
* The statistical data shall be held in two registers. One register shall contain data since start up and the second register shall contain data from the last maintenance reset.

External DC Power Supply - An optional provision shall be available to connect up to two external 12/24 VDC power supply to allow the LCD and the door mounted control indicators to remain functional when both power sources are dead for extended periods of time. This module shall contain reverse battery connection indication and circuit protection.

PART 3 - EXECUTION

3.1 GENERAL

The transfer switch shall be installed as shown on the plans, in accordance with the manufacturer’s recommendations and all applicable codes.
3.2 INSTALLATION

A. Starting contacts for all transfer switches shall be wired to the generator starting circuit so that any transfer switch that senses a loss of normal power will start the generator. This includes contacts as part of the fire pump controller. This control wiring is not shown on the plans but is required to be provided by the electrical contractor.

B. Control wiring for Emergency Systems (NEC 700) and Fire Pump (NEC 695) shall be kept entirely independent of all other wiring and shall be installed per NEC 700.9 (D)(1) and NEC 695.14 (F).

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Provide and install materials for a complete grounding system integral with the power distribution in accordance with the National Electrical Code.
B. Distribution grounding system.
C. Equipment grounding system.

1.2 RELATED DOCUMENTS
A. Applicable provisions of Division 1 shall govern work under this section.
B. Specified Elsewhere:
   1. 26 11 00 Raceways and Boxes
   2. 26 12 00 Low Voltage Conductors and Cables

1.3 QUALITY ASSURANCE
A. Regulatory Requirements:
   2. National Electrical Code, NEC: Comply with NEC/NFPA No. 70, as applicable to materials and installation of electrical grounding systems and associated equipment and wiring.
   3. Underwriters Laboratories:
      a. Comply with UL Standards pertaining to electrical grounding and bonding.
      b. UL 467: Grounding and Bonding Equipment.

PART 2 - PRODUCTS

2.1 MATERIALS
A. Materials used for grounding conductors shall be as called for in National Electrical Code Article #250-81.
B. Ground Fittings:
   1. OZ Company:
      a. Type BF
      b. Type OG
      c. Type LG
      d. Type MG

2.2 MECHANICAL CONNECTORS
A. The mechanical connector bodies shall be manufactured from high strength, high conductivity cast copper alloy material. Bolts, nuts, washers and lockwashers shall be made of Silicon Bronze and supplied as a part of the connector body and shall be of the two bolt type.
B. Split bolt connector types are NOT allowed. Exception: the use of split bolts is acceptable for grounding of wire-basket type cable tray, and for cable shields/straps of medium voltage cable.
The connectors shall meet or exceed UL 467 and be clearly marked with the catalog number, conductor size and manufacturer.

### 2.3 COMPRESSION CONNECTORS

A. The compression connectors shall be manufactured from pure wrought copper. The conductivity of this material shall be no less than 99% by IACS standards.

B. The connectors shall meet or exceed the performance requirements of IEEE 837, latest revision.

C. The installation of the connectors shall be made with a compression, tool and die system, as recommended by the manufacturer of the connectors.

D. The connectors shall be clearly marked with the manufacturer, catalog number, conductor size and the required compression tool settings.

E. Each connector shall be factory filled with an oxide-inhibiting compound.

### 2.4 WIRE

A. Material: Stranded copper (aluminum not permitted).

B. Feeder and Branch Circuit Equipment Ground: Size as shown on drawings, specifications or as required by NFPA 70, whichever is larger. Differentiate between the normal ground and the isolated ground when both are used on the same facility.

### PART 3 - EXECUTION

#### 2.1 GENERAL

A. Install Products in accordance with manufacturer's instructions.

B. Mechanical connections shall be accessible for inspection and checking. No insulation shall be installed over mechanical ground connections.

C. Ground connection surfaces shall be cleaned and all connections shall be made so that it is impossible to move them.

D. Attach grounds permanently before permanent building service is energized.

#### 2.2 LESS THAN 600 VOLT SYSTEM GROUNDING

A. Bond together system neutrals, service equipment enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground connectors, and plumbing systems.

B. Equipment Grounding Conductor: Provide separate, insulated equipment grounding conductor within each raceway. Terminate each end on suitable lug, bus, enclosure or bushing. Provide a ground wire from each device to the respective enclosure.

#### 3.3 INSTALLATION

A. Electrical service, electrical equipment enclosures and associated metallic raceway system shall be permanently grounded and bonded together by a grounding electrode conductor as per NEC requirements with a ground clamp to a 1-1/4 inch or larger cold water metallic pipe on street side of water meter and ground rod electrodes.

1. Provide water meter shunt; cable to pipe connections copper cable shunt.
B. Bond main switches, ground rods, foundation reinforcement rebar and water service entrance together with ground electrodes sized per code.
   1. Ground connection surfaces shall be clean.
   2. Bond structural steel frame to grounding electrode conductor.

C. Damp Locations: All convenience outlets, switches, fixtures, boxes and plates in damp locations or outdoors shall be fully grounded by a separate green grounding conductor.

D. Panelboard Grounding: Install grounding conductor from main service to each panelboard and ground bar as indicated on Drawings:
   1. Provide separate circuit grounding conductors to dedicated ground circuits, surge suppression receptacles (computers), and GFI receptacles.

E. Bonding Jumpers:
   1. Maintain ground continuity by separate insulated green ground wire in fixture cords, flexible connections or similar location where raceway system is interrupted.
   2. Light Fixtures: Provide separate green wire grounded from fixture housing to nearest conduit system box, where flexible conduit is used.
   3. Receptacles: Provide green wire bonding jumper from all new receptacles to metal back box.

F. Motors: Provide insulated grounding conductor from motor connection to distribution panel grounding bus for all motors.
   1. Where motors are connected to conduit systems with flexible conduit section, install greenfield grounding conductor in flexible conduit section.

G. Equipment Grounding Conductors: Provide separate, insulated grounding conductor within each feeder raceway.
   1. Ground cable tray at intervals not exceeding 100 feet.

H. Device Boxes: Provide new green wire ground from panel ground bar to all new devices located in the raceway systems.
   1. Provide dedicated ground wire to GFI and surge suppression receptacles.

END OF SECTION
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Provide and install lighting fixtures, supports and accessories for mounting condition encountered.

1.2 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:
   1. 26 11 00 Raceways and Boxes
   2. 26 12 00 Low Voltage Conductors and Cables
   3. 26 51 10 Lighting Control Systems

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Certified Ballasts Manufacturers Association, CBM: Ballast labeled by CBM.
   2. National Electrical Code, NEC: Comply with NEC/NFPA No. 70, as applicable to installation and construction of interior lighting fixtures.
   3. Life Safety Code: Comply with NFPA 101 as applicable to exit signs.
   4. Underwriter's Laboratories, UL:
      a. Interior lighting fixtures listed and labeled by UL.
      b. UL 57: Electric lighting fixtures.

1.4 REFERENCES

A. Standards:
   1. American National Standards Institute, ANSI: Comply with applicable ANSI standards pertaining to lamp materials and lighting ballasts.

B. Manufacturers:
   1. National Electrical Manufacturer's Association, NEMA: Comply with applicable portions of NEMA standards pertaining to lighting equipment.

1.5 SUBMITTALS

A. Submit in accordance with Division 1 and Section 16050.
   1. Shop Drawings: Submit shop drawings for luminaires indicating pertinent physical characteristics and photometric data.

1.6 DELIVERY, STORAGE AND HANDLING

A. Acceptance: Deliver interior lighting fixtures individually wrapped in factory fabricated fiberboard type containers.

B. Storage:
   1. Store interior lighting fixtures in clean, dry space.
   2. Store in original cartons and protect from dirt, physical damage, weather and construction traffic.
C. Handling:
1. Handle interior lighting fixtures carefully to prevent breakage, denting and scoring fixture finish.
2. Do not install damaged lighting fixtures.
3. Replace and return damaged units to equipment manufacturer.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS
A. Refer to fixture schedule. Engineer has final decision on whether submitted fixture is equal.
B. Other fixture manufacturers who consider their products equal to those specified are required to request approval for bidding as base bid in accord with Instructions to Bidders section.
C. Approval of products will be considered subject to the following:
1. Equal manufacturers are required to nominally meet specifications of specified fixtures and lenses in regard to ceiling opening size and shape, housing, and trim/door appearance and construction, general overall appearance, efficiency, thickness, brightness control and lamp hiding characteristics.
2. Provide equivalent performance to specified fixtures considering application in the environment and intended usage by the Owner.
3. Manufacturers shall submit complete fixture and lens data for evaluation and shall be prepared to submit sample fixtures and/or lenses. Samples shall be submitted only at the request of the Engineer.

2.2 GENERAL
A. Subject to compliance with requirements, fixtures that may be incorporated into the work include the products specified in the Lighting Fixture Schedule on the drawings, and the equals listed in the accompanying notes.
B. The basic catalog number only is indicated in the Lighting Fixture Schedule. The EC shall furnish complete lighting fixtures in quantities, and/or row lengths as shown on the plans, including plaster frames, ends, or caps, couplings, connectors, suspension assemblies, mounting brackets and all auxiliary accessories as required.
C. Refer to Schedule for description of fixture nomenclature and associated ceiling type and suspension system.

2.3 LUMINAIRES
A. Housings:
1. Shall be free from burrs, sharp corners and edges.
2. Shall be steel, unless noted otherwise, formed and supported to prevent warping and sagging.
3. Provide spring loaded latches for all troffers.
4. Provide UL approved earthquake clips for all troffers.
5. Provide locking sockets for fluorescent lamps.
B. Mounting Accessories:
1. Recessed fixtures:
   a. Provide trim type and accessories required for installation in ceiling types specified and/or shown on the reflected ceiling plan.
   b. Fixtures mounted in sloped ceilings shall be provided with sloped ceiling adapters and appropriate trim rings and other accessories as required.
2. Surface-mounted fixtures:
   a. Provide ceiling spacers as required for fixtures not labeled as suitable for direct mounting to a low density ceiling.
3. Suspended fixtures:
   a. Provide swivel canopy to accommodate any sloped ceilings shown on the plans.
   b. Provide pendant or cable length required to suspend luminaires at indicated height.
c. Swivel hangers in mechanical equipment areas shall be shock-absorbing type.

C. Finishes:
1. Painted finishes:
   a. Shall be polyester powder painted enamel finish.
2. Polished, brushed, other metal finishes:
   a. Shall be finished with clear coat to inhibit finish deterioration and corrosion.
3. All finish types and colors shall be verified with the architect prior to ordering.

D. Louvers, Reflectors, Lenses:
1. All louvers and reflectors shall be semi-specular, low iridescent, clear alzak, unless noted otherwise.
2. Provide reflector channels to separate all lamp sections.
3. All acrylic lenses shall be pattern 12 prismatic, overall 0.125" minimum thickness.

2.4 LED LIGHTING

A. The manufacturer of the LED lighting fixture shall utilize high-brightness LEDs and high-efficiency electronic LED drivers, dimmed or no dimmed as required.

B. The LED fixture shall be thermally designed as to not exceed the maximum junction temperature of the LED for the ambient temperature of the location the fixture is to be installed.

C. Light output of the LED system shall be the absolute photometry following IESNA LM-79 and IESNA LM-80 requirements and guidelines.

D. Minimum power factor of 0.90.

E. LED lighting fixture shall be mercury-free, lead-free and RoHS compliant.

F. The LED lighting fixture shall maintain 70% lumen output for a minimum of 50,000 hours.

G. All components of the LED lighting fixture shall be replaceable.

H. The LED lighting fixture shall carry a limited 3-year warranty minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:
1. It shall be the Contractor's responsibility to determine mounting requirements and verify ceiling types and to coordinate locations of lighting with other contractors to assure that installation will not interfere with other equipment.
2. Anchor surface mounted fixtures on walls or ceilings in a manner to prevent rotation and light leakage. Do not use plastic, composition or wood type anchors.
3. Provide pendant mounted fixtures with self-aligning stem hangers and rigid steel conduit stems, cut and threaded to fit required length. One stem must serve as wireway.
4. Mount suspended fixtures at heights indicated on the drawings. If height is not indicated, mount as high as possible, but not above lowest point of mechanical equipment.
5. Support all suspended fixtures from structural building components. Unless directed otherwise, do not suspend from other suspended equipment.
6. Support system capable of supporting 300% fixture and lamp weight.

B. Recessed Luminaires:
1. Install recessed luminaire to permit removal from below for access to outlet or prewired fixture box.
2. Connect recessed luminaire to boxes with flexible conduit and fixture wire.
3. Suspended ceiling with exposed tee bar grid system. Support from ceiling tee bar grid structure and with bolts, screws, rivets or approved ceiling framing member clips.

C. **Lay-In Luminaires**:

1. Install with plastic protection over louver.
2. Remove plastic protection after final clean up.
3. Fixtures used for temporary lighting shall have louver removed and safely stored.
4. Any contact with louver shall be made utilizing clean gloves to prevent fingerprints on specular finish.

### 3.2 FIELD QUALITY CONTROL

A. At time of substantial completion, replace lamps in fixtures, which are observed to be noticeably dimmed after Contractor's use and testing as judged by Architect-Engineer.

B. Prior to final acceptance replace all cracked or broken lenses, dented, scratched or otherwise damaged fixtures at no cost to the Owner.

### 3.3 ADJUST AND CLEAN

A. Align luminaires and clean diffusers prior to final acceptance.

B. Provide lamps, as scheduled, for each luminaire.

### 3.4 SCHEDULES

A. Lighting Fixture Schedule on Drawings.

**END OF SECTION**
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Furnish all labor, equipment, materials, and performing all operations in connection with the installation of the Lighting Control System as shown on the drawings, as hereinafter specified, and as directed by the Engineer. The intent of this specification is to provide for furnishing, installing, testing and placing in operation, the necessary equipment for switching and control of lighting systems.

B. Extent of lighting control system work is indicated by drawings and by the requirements of this section. Types of lighting control equipment and wiring specified in this section includes the following:

1. Occupancy sensor controls.
2. Programmable lighting controllers.

C. Requirements are indicated elsewhere in these specifications for work including, but not limited to, raceways, electrical boxes and fittings, and routers or other network components required for installation of control equipment, which are not work of this section.

1.2 LIGHTING CONTROL SYSTEM OPERATION

A. It shall be the contractor's responsibility to make all proper adjustments to assure owner's satisfaction with the lighting control system.

B. Factory Startup: It shall be the manufacturer's responsibility to verify all proper adjustments and train owner's personnel to ensure owner's satisfaction with the occupancy system. This service is provided at an additional cost.

1.3 RELATED DOCUMENTS

A. Applicable provisions of Division 1 shall govern work under this section.

B. Specified Elsewhere:

1. 26 05 00 Basic Materials and Methods
2. 26 11 00 Raceways and Boxes
3. 26 19 00 Supporting Devices
4. 26 51 00 Interior Building Lighting

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Local and state building codes.
2. All requirements of the local authority having jurisdiction.
3. Underwriter's Laboratories: The system and all components shall be listed by Underwriters Laboratories, Inc. for use in fire protective signaling systems under the following standards as applicable.

B. Codes and Standards:

1. Network - ANSI 875.1, ARCNET®
4. UL 916 Energy Management Equipment
5. California Energy Commission
C. Independent Testing Laboratory - The control panels shall be tested and listed under the UL 916 Energy Management Equipment standards.

D. System Checkout and Training - A factory trained technician or other factory-authorized personnel shall functionally test the system and verify performance after contractor installation. Factory authorized personnel shall conduct a training session to train the building operations personnel on the set-up, programming, operation and maintenance of the lighting control systems.

E. Warranty - Manufacturer shall provide a one (1) year limited warranty on the lighting control system and software. A ten (10) year limited warranty shall be provided on the lighting control relays.

1.5 SUBMITTALS

A. Submit in accordance with Section 23 05 00.

B. Submit complete documentation showing the type, size, rating, style, catalog number, manufacturer's names, photos and or catalog data sheets for all items to ensure compliance with these specifications.

C. Prior to fabrication manufacture shall submit the following materials for approval:

1. Manufacturer’s published catalog data sheets for all equipment and components of the lighting control system.
2. Shop Drawings - Submit drawings of lighting control system and accessories including, but not necessarily limited to, the central programming system, intelligent relay/dimmer panels, network wiring, switch inputs, analog inputs and modem location. As a minimum, the shop drawings shall include the following:
   • One-line schematic diagram with wire type details
   • Network wiring details
   • Lighting control panel load schedules
   • Input and output wiring details
   • Programming worksheets for system configurations

D. Submit point list for owner to complete custom label requirements.

E. All references to manufacturer's or supplier's model numbers and other pertinent information herein is intended to establish minimum standards for performance, function and quality. Equivalent equipment (compatible UL listed) from other manufacturers may be substituted for that specified providing the submittal is performed as specified above.

1.6 DELIVER, STORAGE AND HANDLING

A. Deliver equipment individually wrapped in factory fabricated fiberboard type containers.

B. Store equipment in clean, dry space.

C. Protect from dirt, fumes, water and physical damage.

D. Do not install damaged equipment, remove from site.

1.7 FIELD PROGRAMMING

A. The system shall be programmable, configurable and expandable in the field without the need for special tools or PROM programmers and shall not require replacement of memory ICs. All standard control panel keyboard or through the use of the optional CRT-1 keyboard. All programs shall be stored in non-volatile memory.

B. The programming function shall be entered with a special password that may be selected when the system is installed. The password may be changed in the field to a new value at any time by entering the old password and requesting a password change. In the event that the programmer may enter a password and then lose or forget it,
the system shall be designed such that the password may be determined by special procedures available through the system manufacturer.

PART 2 - PRODUCTS

2.1 OCCUPANCY SENSOR CONTROLS

A. Occupancy Sensors shall be equal to Sensor Switch Watt Stopper, Hubbell/Unenco, Novitas, or approved equal.

1. Line voltage occupancy sensors may be used in lieu of low-voltage sensors where approved by the Engineer for areas with inaccessible power pack locations.

B. Wall switch sensors shall be capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.

C. Wall switch sensors shall accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180° coverage capability.

D. Wall switch products shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.

E. Wall switch sensors shall have no leakage current to load, in manual or in Auto/Off mode for safety purposes and shall have voltage drop protection.

F. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from automatic-ON to manual-ON.

G. Where specified, vandal resistant wall switch sensors shall utilize a hard lens with a minimum 1.0mm thickness. Products utilizing a soft lens will not be considered.

H. Passive infrared sensors shall utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion.

I. Passive infrared sensors shall utilize mixed signal ASIC which provides high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line), superior performance, and greater reliability.

J. Passive infrared sensors shall have a multiple segmented Ludif Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.

K. Where specified, passive infrared and dual technology sensors shall offer daylighting footcandle adjustment control and be able to accommodate dual level lighting.

L. Dual technology sensors shall be corner mounted to avoid detection outside the controlled area when doors are left open.

M. Dual technology sensors shall consist of passive infrared and ultrasonic technologies for occupancy detection. Products that react to noise or ambient sound shall not be considered.

N. Ultrasonic sensors shall utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space.

O. Ultrasonic operating frequency shall be crystal controlled at 25 kHz within ± 0.005% tolerance, 32 kHz within ± 0.002% tolerance, or 40 kHz ± 0.002% tolerance to assure reliable performance and eliminate sensor cross-talk. Sensors using multiple frequencies are not acceptable.

P. All sensors shall be capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.
Q. Coverage of sensors shall remain constant after sensitivity control has been set. No automatic reduction shall occur in coverage due to the cycling of air conditioner or heating fans.

R. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

S. In the event of failure, a bypass manual override shall be provided on each sensor. When bypass is utilized, lighting shall remain on constantly or control shall divert to a wall switch until sensor is replaced. This control shall be recessed to prevent tampering.

T. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

U. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

V. All sensors shall have UL rated, 94V-0 plastic enclosures.

2.2 OCCUPANCY SENSOR CIRCUIT CONTROL HARDWARE

A. Control Units - For ease of mounting, installation and future service, control unit(s) shall be able to externally mount through a 1/2” knock-out on a standard electrical enclosure and be an integrated, self-contained unit consisting internally of an isolated load switching control relay and a transformer to provide low-voltage power. Control unit shall provide power to a minimum of two (2) sensors.

B. Relay Contacts shall have ratings of:

- 13A - 120 VAC Tungsten
- 20A - 120 VAC Ballast
- 20A - 277 VAC Ballast

C. Control wiring between sensors and controls units shall be Class II, 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums, where applicable.

D. Minimum acceptable wire gauge from the circuit control hardware relays shall be #14 AWG.

2.3 PROGRAMMABLE LIGHTING CONTROLLERS

A. The programmable lighting controller shall consist of intelligent lighting control panel(s) with programmable digital and analog inputs, integral astronomic time-clock scheduling with flash warn before OFF feature and provision for up to 16 relay outputs. The specified system for this project shall include the following components:

1. LCP -1: Eight(8) Relay digital programmable lighting controller.
2. Programmable digital time clock;
3. one(1) low-voltage input switches;
4. Photocell input;
5. Alphanumeric key pad programming and LCD display.

B. Standard Output relays

1. UL Listed 30 Amp @ 277VAC Ballast and HID and 20 Amp Tungsten at 120 Vac. 347V Ballast and HID at 20 amps Latching Relay wit 18,000A SCCR at 277Vac.
2. Relays shall be individually replaceable. Relay terminal blocks shall be capable of accepting two (2) #8AWG wires on both the line and the load side. Relays to be rated for 250,000 operations minimum at a full 30a lighting load.
3. Standard relay shall default to closed at normal power loss, Normally Closed Latching (NCL).
4. Optional relay types available shall include: Normally Open Latching (NOL) relay rated for 250,000 operations, a 600v 2-pole NO and NC and a Single Pole, Double Throw (SPDT) relay.

C. Low Voltage Switches
1. All switches shall be digital and communicate via RS 485. The programming for a digital switch shall reside in the switch itself, via double EPROM memory. Any digital switch button function shall be able to be changed locally (at the DTC or a PC) or remotely via Internet.

2. Digital low voltage switch shall be a device that sits on the lighting control system bus. Digital switch shall connect to the system bus using the same cable and connection method required for relay panels. Each button shall be able to be enabled or disabled over the bus.

3. Keyed switches shall be similarly programmable and connect to the lighting control system bus.

4. Digital switches for high abuse areas (common areas, gymnasiums, etc.) shall be vandal resistant, contain no moving parts, and be touch sensitive and available with up to two buttons in a single gang.

5. Touch pads shall be Stainless Steel and capable of handling both high abuse and wash down locations.

6. High abuse switches shall connect to the lighting control system digital bus. Each high abuse touch button shall be able to be programmed in the same way as other digital switch buttons.

D. Programming shall be accomplished through an integral keypad and display on the unit or via PC software using a local LAN connection over internet connection.

E. Approved Manufacturers:

1. LC&D;
2. Douglas;
3. Approved equal.

2.4 WIRE AND CABLE

A. All low voltage cable and wire shall be supplied and installed in accordance with the National Electrical Code and other provisions of Division 26

B. Cable and wire selected for each application shall be in strict accordance with the original equipment manufacturers recommendations.

C. All cables and wires shall be permanently tagged at both ends for ease in maintenance.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION AND DOCUMENTATION

A. Installation - The control system shall be installed and connected as shown on the plans and as directed by the manufacturer. The contractor shall complete all electrical connections to all control circuits, network terminations, RS-232 connections, sensors and override wiring.

B. Documentation - The contractor shall provide accurate "as built" drawings to the owner indicating the correct and latest program in each controller. The "as-built drawings" shall clearly indicate the lighting control panel identification, the load controlled by each relay, and the device connected to each input.

C. Operation and Service Manuals – Provide operation and service manuals for all system components as indicated in the General Provisions.

3.2 PRODUCT SUPPORT AND SERVICE

A. System Start-up: Provide a factory authorized technician to verify the installation, test the system, and train the owner on proper operation and maintenance of the system. Before requesting start-up services, the installing contractor shall verify that:

1. The control system has been fully installed in accordance with manufacturer's installation instructions.
2. Low voltage wiring for overrides and sensors is completed.
3. Accurate "as-built" load schedules have been prepared for each lighting control panel.
4. Proper notification of the impending start-up has been provided to the owner’s representative.
B. Factory Support: Factory telephone support shall be available at no cost to the owner during the warranty period. Factory assistance shall consist of assistance in solving programming or other application issues pertaining to the control equipment. The factory shall provide a toll-free number for technical support.

3.3 OCCUPANCY SENSOR CONTROL INSTALLATION

A. It shall be the contractor's responsibility to locate and aim sensory in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Rooms shall have ninety (90) to one hundred (100) percent coverage to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the room(s). The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. The contractor shall provide additional sensors if required to properly and completely cover the respective room.

B. It is the contractors responsibility to arrange a pre-installation meeting with the manufacturer's factory authorized representative, at the owner's facility, to verify placement of sensors and installation criteria.

C. Proper judgment must be exercised in executing the installation so as to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components. The contractor shall also provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing devices and systems.

3.4 PROGRAMMABLE LIGHTING CONTROLLER INSTALLATION

A. Startup and Owner Services: Authorized lighting controller representative shall startup and program lighting controller per Owner's schedules.

1. Submit startup report and final lighting schedules for approval and inclusion in O&M manuals.
2. Provide 2 hours of Owner training in the proper operation and maintenance of the lighting control system.

3.5 TESTS AND REPORTS

A. Final Acceptance: The system will be accepted only after a satisfactory test of the entire system has been accomplished by a factory-trained distributor in the presence of the Owner's Representative.

B. On-Site Services: Contractor shall provide the on-site services of an authorized technical representative of the manufacturer, to supervise all connections and fully test all devices and components of the system as installed. Owner's representative shall be instructed in the proper use and testing of the system.

3.6 BASIC OPERATOR TRAINING

A. Installation Contractor and equipment vendor shall provide all training materials, testing equipment, and demonstration aids required to provide operator, supervision, and maintenance personnel training. At completion of the training period, all training brochures, bulletins, manuals, handbooks, and diagnostic guidelines shall remain with the Owner.

END OF SECTION
SECTION 31 0513 – SOILS FOR EARTHWORK

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Subsoil materials.
   2. Topsoil materials.

B. Related Sections:
   1. Section 31 0516 - Aggregates for Earthwork.
   2. Section 31 2316.13 - Trenching.
   3. Section 31 2323 - Fill.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

B. ASTM International:
   1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
   2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft3 (2,700 kN-m/m3)).
   3. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

1.3 SUBMITTALS

A. Materials Source: Submit name, source location and supplier of imported materials.

1.4 QUALITY ASSURANCE

A. Furnish each subsoil and topsoil material from single source throughout the Work.

PART 2 – PRODUCTS

2.1 SUBSOIL MATERIALS

A. Subsoil Type (S1) Granular Fill:
   1. Clean material meeting the requirements of “Grade 1” or “Grade 2” granular backfill as defined in WisDOT Section 209.2.1.

B. Subsoil Type (S2) Structural Fill:
   1. Clean material meeting the requirements of “Structure Backfill” as defined in WisDOT Section 210.2.1.

C. Subsoil Type (S3) Earth Fill:
   1. Use clean material consisting of inorganic soil or a mixture of inorganic soil and rock, stone or gravel. The material shall be free of topsoil, sod, stumps, wood, asphalt, concrete, debris, and
other deleterious material. The maximum dimension of any material shall not exceed 3” in any direction.

2.2 TOPSOIL MATERIALS

A. Topsoil Type (S4) Onsite Topsoil:
   1. Excavated and reused material.
   2. Reasonably free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds and foreign matter.
   3. Conforming to ASTM D2487 Group Symbol OH.

B. Topsoil Type (S5) Imported Topsoil:
   1. Imported borrow.
   2. Friable loam.
   3. Graded / Screened.
   4. Free of roots, rocks larger than 1/2 inch, subsoil, debris, large weeds, and foreign matter.
   5. Containing minimum of 8 percent and maximum of 25 percent inorganic matter.
   6. Conforming to ASTM D2487 Group Symbol OH.

PART 3 – EXECUTION

3.1 EXCAVATION

A. Excavate subsoil and topsoil from areas designated. Strip topsoil to full depth of topsoil in designated areas.

B. Stockpile excavated material meeting requirements for subsoil materials and topsoil materials.

C. Remove excess excavated materials not intended for reuse, from site.

D. Remove excavated materials not meeting requirements for subsoil materials and topsoil materials from site.

3.2 STOCKPILING

A. Stockpile materials on site at locations acceptable to the Owner.

B. Stockpile in sufficient quantities to meet Project schedule and requirements.

C. Separate differing materials with dividers or stockpile apart to prevent mixing.

D. Stockpile topsoil 15 feet high maximum.

E. Prevent intermixing of soil types or contamination.

F. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

3.3 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION 31 0513
SECTION 31 0516 – AGGREGATES FOR EARTHWORK

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   2. Fine aggregate materials.

B. Related Sections:
   1. Section 31 0513 - Soils for Earthwork
   2. Section 31 2316 – Excavation.
   3. Section 31 2316.13 - Trenching
   4. Section 31 2323 - Fill.
   5. Section 32 1123 – Aggregate Base Courses.

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

B. ASTM International:
   2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
   3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
   4. ASTM D2487 - Standard Classification of Soils for Engineering Purposes (Unified Soil Classification System).

1.3 SUBMITTALS

A. Materials Source: Submit name and location of imported materials suppliers.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Provide aggregate materials from sources approved by State of Wisconsin Department of Transportation.

PART 2 – PRODUCTS

2.1 COARSE AGGREGATE MATERIALS

A. Coarse Aggregate Type (A1) 3/4-Inch Dense Graded Base Aggregate: Conforming to State of Wisconsin DOT Standard Specifications Section 305; within the following limits:
### Sieve Size and Percent Passing

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch</td>
<td>100</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>95 to 100</td>
</tr>
<tr>
<td>3/8 inches</td>
<td>50 to 90</td>
</tr>
<tr>
<td>No. 4</td>
<td>35 to 70</td>
</tr>
<tr>
<td>No. 10</td>
<td>15 to 55</td>
</tr>
<tr>
<td>No. 40</td>
<td>10 to 35</td>
</tr>
<tr>
<td>No. 200</td>
<td>5 to 15</td>
</tr>
</tbody>
</table>

#### B. Coarse Aggregate Type (A2) 1 1/4-Inch Dense Graded Base Aggregate:

Conforming to State of Wisconsin DOT Standard Specifications Section 305, within the following limits:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 1/4 inches</td>
<td>95 to 100</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>70 to 93</td>
</tr>
<tr>
<td>3/8 inches</td>
<td>42 to 80</td>
</tr>
<tr>
<td>No. 4</td>
<td>25 to 63</td>
</tr>
<tr>
<td>No. 10</td>
<td>16 to 48</td>
</tr>
<tr>
<td>No. 40</td>
<td>8 to 28</td>
</tr>
<tr>
<td>No. 200</td>
<td>2 to 12</td>
</tr>
</tbody>
</table>

#### C. Coarse Aggregate Type (A3) 3-Inch Dense Graded Base Aggregate:

Conforming to State of Wisconsin DOT Standard Specifications Section 305; within the following limits:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>3 inches</td>
<td>90 to 100</td>
</tr>
<tr>
<td>1 1/2 inches</td>
<td>60 to 85</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>40 to 65</td>
</tr>
<tr>
<td>No. 4</td>
<td>15 to 40</td>
</tr>
<tr>
<td>No. 10</td>
<td>10 to 30</td>
</tr>
<tr>
<td>No. 40</td>
<td>5 to 20</td>
</tr>
<tr>
<td>No. 200</td>
<td>2 to 12</td>
</tr>
</tbody>
</table>

#### D. Coarse Aggregate Type (A4) 3/4-Inch Clear Crushed Stone:

Crushed clear stone or gravel; within the following limits:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 inch</td>
<td>100</td>
</tr>
<tr>
<td>3/4 inch</td>
<td>90 - 100</td>
</tr>
<tr>
<td>3/8 inches</td>
<td>20 to 55</td>
</tr>
<tr>
<td>No. 4</td>
<td>0 to 10</td>
</tr>
<tr>
<td>No. 8</td>
<td>0 to 5</td>
</tr>
</tbody>
</table>
Coarse Aggregate Type (A5) 3/8 - Inch Clear Crushed Stone Chips: Crushed clear stone or gravel; within the following limits:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2 inch</td>
<td>100</td>
</tr>
<tr>
<td>3/8 inches</td>
<td>90 to 100</td>
</tr>
<tr>
<td>No. 8</td>
<td>0 to 15</td>
</tr>
<tr>
<td>No. 30</td>
<td>0 to 3</td>
</tr>
</tbody>
</table>

E. Aggregate Type (A6) Breaker Run (Breaker): Conforming to State of Wisconsin DOT Standard Specifications Section 311.

F. Aggregate Type (A7) Pea Gravel: Natural stone; washed, free of clay, shale and organic matter.

1. Graded in accordance with ASTM C136, within the following limits:
   a. Minimum Size: 1/4-inch
   b. Maximum Size: 3/8-inch

2.2 FINE AGGREGATE MATERIALS

A. Fine Aggregate Type (A10) Bedding Sand (Sand): Natural river or bank sand; free of silt, clay, loam, friable or soluble materials, and organic matter; graded in accordance with ASTM C136 within the following limits:

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Inch</td>
<td>100</td>
</tr>
<tr>
<td>No. 16</td>
<td>45 to 80</td>
</tr>
<tr>
<td>No. 200</td>
<td>2 to 10</td>
</tr>
</tbody>
</table>

2.3 SOURCE QUALITY CONTROL


C. When tests indicate materials do not meet specified requirements, change material and retest.

PART 3 – EXECUTION

3.1 EXCAVATION

A. Excavate aggregate materials from on-site locations indicated or designated by Architect/Engineer as specified in Section 31 2316.

B. Stockpile excavated material meeting requirements for coarse aggregate materials and fine aggregate materials.

C. Remove excess excavated materials coarse aggregate materials and fine aggregate materials not intended for reuse, from site.
3.2 STOCKPILING

A. Stockpile materials on site, within the property boundary, in sufficient quantities to meet Project schedule and requirements.

B. Separate different aggregate materials with dividers or stockpile individually to prevent mixing.

C. Direct surface water away from stockpile site to prevent erosion or deterioration of materials.

D. Stockpile unsuitable hazardous materials on impervious material and cover to prevent erosion and leaching, until disposed of.

3.3 STOCKPILE CLEANUP

A. Remove stockpile, leave area in clean and neat condition. Grade site surface to prevent free standing surface water.

END OF SECTION 31 0516
SECTION 31 1000 – SITE CLEARING

1.1 SUMMARY

A. Section Includes:
   1. The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to clear and grub the site of existing vegetation as required in these specifications and on the drawings.

B. Related Sections:
   1. Section 31 0513 – Soils for Earthwork
   2. Section 31 2323 – Fill

1.2 CLEARING LIMITS

A. Confine clearing and grubbing operations to the limits as indicated on the drawings. In the absence of such a designation on the drawings, confine work to the minimum area reasonably necessary to undertake the work as determined by the Owner's Project Representative. Clearing and grubbing operations shall not extend past the property line or easement line without prior approval of the Construction Representative.

PART 2 PRODUCTS

NOT USED

PART 3 EXECUTION

3.1 GENERAL

A. Limits of clearing and grubbing shall be as shown on plans. When selective pruning and removal is specified, limit work to only those plants or limbs shown drawings or scheduled.

B. Remove trees, stumps, roots, brush, other vegetation, debris, and other items that interfere with new construction.

C. To minimize erosion, limit heavy equipment travel only to that necessary to complete clearing and grubbing operations.

D. Repair damaged erosion control features immediately.

3.2 CUTTING

A. Fell and prune trees in manner so as not to damage adjacent structures, site features or other plants not scheduled for removal. Use tag lines and other devices as necessary to control falling tree and limbs.

B. When pruning, limit removal only to those limbs shown on plans or that which is necessary to complete other sitework.

C. When pruning, make cuts near trunk, but beyond branch collar. If no branch collar is present, make a vertical cut near where the limb meets the trunk. Do not cut branch collar.

D. Use sharp tools and make clean cuts.

E. Application of wound paint is not necessary.
3.3 ONSITE BURIAL OF MATERIALS
   A. Onsite burials of materials in borrow pits or other locations is not permitted.

3.4 OFFSITE DISPOSAL OF MATERIALS
   A. Clearing and grubbing debris shall be disposed of at facilities designed to accept the material that is being disposed. Follow all local, state and federal regulations.

3.5 GRUBBING
   A. Grubbing operations may be completed by removal of stump section or by grinding.
   B. Remove stumps, logs, roots, other organic matter located within proposed building excavations completely.
   C. Remove stumps, logs, roots, other organic matter located within proposed pavements and structures to the minimum depth indicated:
      1. Walks: 24 inches below finish subgrade
      2. Roads and drives and parking areas: 36 inches below finish subgrade
      3. Concrete slabs: 24 inches below finish subgrade
      4. Lawn areas: 12 inches below finish subgrade
      5. Footings and foundations for signs, lights, etc.: 18 inches below footing base
   D. Depressions resulting from grubbing operations shall be backfilled in accordance with Section 31 2323 – Fill.

END OF SECTION 31 1000
SECTION 31 2216.15 – ROADWAY SUBGRADE PREPARATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. The work under this section shall consist of providing all work, materials, labor, equipment, and supervision necessary to complete pavement subgrade preparation and provide a surface ready for constructing and supporting the Aggregate Base Course, as required in these specifications, on the drawings and as otherwise deemed necessary to complete the work.

B. Related Sections:
   1. Section 31 2316 – Excavation
   2. Section 31 2316.13 – Trenching
   3. Section 32 1123 – Aggregate Base Course

1.2 REFERENCES

A. Where these specifications do not cover portions of the work to be undertaken, the SSHSC in Wisconsin, current edition, shall govern the work.

1.3 QUALITY ASSURANCE

A. The Contractor shall conduct sampling, testing, and analysis as required by this section and elsewhere in the Contract Documents either by retaining the services of an independent construction materials testing consultant or with internal certified testers. The materials testing consultant shall meet the requirements of ASTM E329.

B. The A/E and Contractor’s construction materials testing personnel shall observe all proof-rolling operations. Provide minimum of 48 hours confirmed notice for all parties.

1.4 PERMITS/FEES

A. Owner has applied for permit coverage from the Wisconsin DNR (WRAPP), Department of Safety and Professional Services (Exterior Stormwater), Dane County Land and Water Resources (Erosion Control and Stormwater), and Dane County Highway (Work in Right-of-Way).

B. Contractor shall be solely responsible for obtaining all additional permits necessary to complete the work. Contractor shall pay all fees associated with obtaining permits.

PART 2 – PRODUCTS

2.1 BREAKER RUN AGGREGATE

A. Crushed stone, rock or gravel meeting the requirements of either Breaker Run or Select Crushed material as defined in WisDOT Section 311.2 or WisDOT Section 312.2, respectively.

2.2 RECYCLED AGGREGATE AND PAVEMENT

A. Recycled or salvaged aggregate and pavement products shall be free of organics, clay, rocks greater than 3-inches in least dimension and all other deleterious materials. The Contractor may submit specifications for these materials for consideration by the A/E for use on the project as part of the submittal process following contract award.
2.3 GEOTEXTILE FABRIC

A. Geotextile Fabric for Subgrade Stabilization: Geotextile fabric installed over subgrade and under aggregate base course shall be a high performance non-biodegradable polypropylene geotextile specifically designed for soil stabilization and soil reinforcement applications. Acceptable products shall comply with the following test values:

<table>
<thead>
<tr>
<th>Test</th>
<th>Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Tensile Strength</td>
<td>GRI Method GG1-87</td>
<td>250 lb/in</td>
</tr>
<tr>
<td>Max. Aperture</td>
<td>Internal Dimension Measuring Calipers</td>
<td>2 in.</td>
</tr>
<tr>
<td>Min. Aperture</td>
<td>Internal Dimension Measuring Calipers</td>
<td>0.5 in</td>
</tr>
<tr>
<td>Min. Ultimate Junction</td>
<td>GRI GG2-87</td>
<td>800 lbs./ft.</td>
</tr>
</tbody>
</table>

PART 3 – EXECUTION

3.1 PREPARATION

A. Review drawings and prepare work plan and schedule.
B. Grade roadways and parking areas to drain water away from buildings.

3.2 EXCAVATION

A. Excavate to elevations and dimensions as shown on the drawings and as necessary to complete construction. Excavations shall be sufficiently deep to provide for depth of base course and pavement.
B. Stones over 6-inches in size shall be removed from the loosened portion of the subgrade.
C. Notify Architect/Engineer if correction of unauthorized excavation or over-excavation is necessary. Said excavations will be corrected by placement of Breaker Run Aggregate. Contractor will be responsible for all costs associated with correcting these excavations.
D. Segregate the various materials excavated. Excavated material that does not meet the requirements of backfill and excess excavated material, shall be removed from the site and disposed by the Contractor.
E. Locate spoil piles so they do not interfere with public travel, adjacent landowners or other construction activities.

3.3 PREPARING THE FOUNDATION

A. The subgrade shall be constructed to have a uniform stability throughout. Use of recycled and salvaged aggregate and pavements shall be fully incorporated into subgrade soil. Construct the foundation to the required elevation with equipment and methods adapted for the purpose. Shape and compact to provide a smooth foundation, at required density, and at the proper elevation to receive the Aggregate Base Course (See Section 32 1123).
B. Compact material to minimize settlement and avoid damage to structures, pipes, utility lines and other features. Hand-place and compact material as necessary.
C. It is the responsibility of the Contractor to provide all necessary compaction equipment and other grading equipment that may be required to obtain a subgrade that satisfies the conditions of a satisfactory subgrade as defined below. Vibratory plate or tamping type walk behind compactors will be required whenever backfill is placed adjacent to structures, pipes, utility lines and other features.

D. The prepared foundation shall be tested for compaction as defined in the paragraph entitled 'Subgrade Approval / Proof Rolling'.

3.4 SUBGRADE APPROVAL / PROOF ROLLING

A. All proof rolling shall be completed in accordance with the requirements of the paragraph entitled 'Quality Assurance' and shall meet the criteria as defined below.

B. To complete proof rolling, entire pavement subgrade shall be provided with a relatively smooth surface, suitable for observing soil reaction during proof rolling.

C. Contractor shall schedule and provide a fully loaded tri-axle dump truck for proof – rolling. Loaded truck shall have a minimum gross operating weight of 30 tons. Test shall be conducted with “tag” or “pusher” axles retracted from the ground. Other test rolling measures may be suitable provided they are approved by the Geotechnical Engineer.

D. Proof rolling shall be accomplished in a series of traverses parallel to the centerline of the driveway, street, or parking area. The truck shall traverse the length of the street or parking area once for each 12’ of width at speeds less than 5 mph. Additional passes along the traverse shall be completed as directed by the Engineer to further define unsatisfactory subgrade.

E. Soft areas, yielding areas, cracked areas or areas where rolling or wave action is observed shall be considered indicative of an unsatisfactory subgrade. Such areas shall be undercut as outlined in subsequent subsections of this specification.

F. Once the subgrade has been proof-rolled and approved, protect the soils from becoming saturated, frozen, or adversely altered.

3.5 UNDERCUTTING/EXCAVATION BELOW SUBGRADE (EBS)

A. Excavated undercut material that does not meet the specifications for fill needed elsewhere on site shall be removed from the site and legally disposed.

B. Undercut areas shall be backfilled with Breaker Run (A6), or with a combination of Breaker Run and Geotextile Fabric in maximum of 10 inch thick lifts (compacted). Breaker Run shall be compacted to 95% Modified Proctor dry density.

C. Following installation and compaction of place Breaker Run material, the area shall be subject to the work defined in the paragraph entitled 'Subgrade Approval / Proof – Rolling'.

D. Undercutting/Excavation Below Subgrade (EBS) work shall include all materials, labor, equipment and supervision necessary to remove the soils from the Project Site considered to be poor from the proof roll and backfill and compact with Breaker Run material brought to the Project Site.

3.6 GEOTEXTILE SUBGRADE STABILIZATION

A. Installation of geotextile fabric for subgrade reinforcement shall be completed only when directed by the Engineer or Owner. Measure and document areas to be covered with geotextile fabric in consultation with Engineer or Owner.
B. Install geotextile fabric per manufacturer’s recommendations.

3.7 RESTORATION

A. Roll all pavement subgrade surfaces using a smooth drum roller to promote an impervious surface and minimize percolation of water into the subgrade.

END OF SECTION 31 2216
SECTION 31 2316 – EXCAVATION

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavating for building foundations.
   2. Excavating for paving, roads, and parking areas.
   3. Excavating for slabs-on-grade.
   4. Excavating for site structures.
   5. Excavating for landscaping.

B. Related Sections:
   1. Section 31 0513 – Soils for Earthwork
   2. Section 31 0516 – Aggregates for Earthwork
   3. Section 31 2316.13 – Trenching
   4. Section 31 2323 – Fill

1.2 REFERENCES

A. ASTM International:
   1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
   2. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).

B. Local utility standards when working within 24 inches of utility lines.

PART 2 – PRODUCTS – Not Used

PART 3 – EXECUTION

3.1 PREPARATION

A. Call Digger’s Hotline not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.

B. Verify locations of locally installed private utilities and conduits. Coordinate with building addition General Contractor and sub-contractors.

C. Identify required lines, levels, contours, and datum.

D. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.

3.2 EXCAVATION

A. Underpin adjacent structures which may be damaged by excavation work.

B. Excavate subsoil to accommodate building foundations, slabs-on-grade, paving and site structures.
C. Compact disturbed load bearing soil in direct contact with foundations to original bearing capacity; perform compaction in accordance with specifications.

D. Slope banks with machine to angle of repose or less until shored.

E. Do not interfere with 45 degree bearing splay of foundations.

F. Grade top perimeter of excavation to prevent surface water from draining into excavation.

G. Trim excavation. Remove loose matter.

H. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume.

I. Notify Architect/Engineer immediately of unexpected subsurface conditions.

J. Remove excess and unsuitable material from site.

K. Repair or replace items indicated to remain damaged by excavation.

3.3 FIELD QUALITY CONTROL

A. Request visual inspection of foundation bearing surfaces by Architect/Engineer before installing subsequent work.

B. Perform Proof-Roll (roll-test) of finished subgrade traffic areas in accordance with Section 31 2216.15. Undercut unsatisfactory materials and replace with breaker run.

3.4 PROTECTION

A. Prevent displacement or loose soil from falling into excavation; maintain soil stability.

B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

C. Protect structures, utilities and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth operations.

END OF SECTION 31 2316
SECTION 31 2316.13 – TRENCHING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Excavating and backfilling site utility trenches for utility piping and appurtenances.

B. Related Sections:
   1. Section 31 0513 – Soils for Earthwork
   2. Section 31 0516 – Aggregates for Earthwork
   3. Section 31 2316 – Excavation
   4. Section 31 2323 – Fill

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

B. ASTM International:
   2. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)).
   3. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lbf/ft³ (2,700 kN-m/m³)).
   5. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).

1.3 DEFINITIONS

A. Utility: Any buried pipe, duct, conduit, or cable.

1.4 SUBMITTALS

A. Materials Source: Submit name of imported fill materials suppliers.

1.5 COORDINATION

A. Verify Work associated with lower elevation utilities is complete before placing higher elevation utilities.

1.6 QUALITY ASSURANCE

A. Warrant trenching and backfilling work under this section against settlement for a period of (1) year after substantial completion.
PART 2 – PRODUCTS

2.1 MATERIALS

A. Subsoil Fill: Type (S1) Granular Fill and (S2) Structural as specified in Section 31 0513.
B. Coarse Aggregates (A4) and (A5) as specified in Section 31 0516.

PART 3 – EXECUTION

3.1 PREPARATION

A. Call Digger’s Hotline not less than three working days before performing Work.
   1. Request underground utilities to be located and marked within and surrounding construction areas.
B. Identify required lines, levels, contours, and datum locations.
C. Protect plant life, lawns, and other features remaining as portion of final landscaping.
D. Protect bench marks, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
E. Maintain and protect above and below grade utilities indicated to remain.
F. Establish temporary traffic control and detours when trenching is performed in public right-of-way. Relocate controls and reroute traffic as required during progress of Work.

3.2 TRENCHING

A. Excavate subsoil required for utilities to utility service.
B. Remove lumped subsoil, boulders, and rock over 6 inches in diameter.
C. Perform excavation within 24 inches of existing utility service in accordance with utility’s requirements.
D. Do not advance open trench more than 100 feet ahead of installed pipe.
E. Cut trenches sufficiently wide to enable installation and allow inspection. Remove water or materials that interfere with Work.
F. Excavate bottom of trenches a minimum of 6 inches and a maximum 12 inches wider than outside diameter of pipe.
G. Excavate trenches to depth indicated on Drawings. Provide uniform and continuous bearing and support for bedding material and pipe.
H. Do not interfere with 45 degree bearing splay of foundations.
I. When Project conditions permit, slope side walls of excavation starting 2 feet above top of pipe. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this section.
J. When subsurface materials at bottom of trench are loose or soft, excavate until suitable material is encountered and backfill with Coarse Aggregate Type A4 or A5.

L. Correct areas over excavated areas with compacted backfill as specified for authorized excavation or replace with fill concrete as directed by Architect/Engineer.

M. Remove excess subsoil not intended for reuse, from site.

3.3 SHEETING AND SHORING

A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.

B. Design sheeting and shoring to be removed at completion of excavation work.

C. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.

D. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.4 UTILITY INSTALLATION

A. Install utility within trench including required bedding and cover materials in accordance with the specifications for each utility.

3.5 BACKFILLING

A. Do not leave more than 50 feet of trench open at end of working day.

B. Protect open trench to prevent danger to the public.

C. Backfill areas to contours and elevations with unfrozen materials.

D. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.

E. Place backfill material and compact in continuous layers in accordance with the schedule at the end of this section.

F. Employ placement method that does not disturb or damage other work.

G. Maintain optimum moisture content of backfill materials to attain required compaction density.

H. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.

I. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.

J. Make gradual grade changes. Blend slope into level areas.

K. Remove surplus backfill materials from site.

L. Leave fill material stockpile areas free of excess fill materials.
3.6 TOLERANCES

A. Top Surface of Backfilling Within Building Areas: Plus or minus 1/2 inch from required elevations.

B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.

C. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.7 PROTECTION OF FINISHED WORK

A. Reshape and re-compact fills subjected to vehicular traffic.

3.8 SCHEDULE

A. Place material in 10-inch max lifts, compact uniformly to 95 percent of maximum dry density (modified proctor), or as shown on the Construction Drawings.

END OF SECTION 31 2316.13
SECTION 31 2323 – FILL

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Backfilling building perimeter to subgrade elevations.
   2. Backfilling site structures to subgrade elevations.
   3. Fill under slabs-on-grade.
   4. Fill under paving.

B. Related Sections:
   1. Section 31 0513 - Soils for Earthwork
   2. Section 31 0516 - Aggregates for Earthwork
   3. Section 31 2316 - Excavation
   4. Section 31 2316.13 - Trenching

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

B. ASTM International:
   1. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft³ (600 kN-m/m³)).
   2. ASTM D1557 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (6,000 ft-lb/ft³ (2,700 kN-m/m³)).

1.3 SUBMITTALS

A. Materials Source: Submit name of imported fill materials suppliers.

1.4 QUALITY ASSURANCE

A. Warrant backfilling work under this section against settlement for a period of (1) year after substantial completion.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Subsoil Fill: (S1) Granular, (S2) Structural, and (S3) Earth as specified in Section 31 0513.

B. Breaker Run: (A6) Breaker Run as specified in Section 31 0516.
PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify sub-drainage, damp-proofing, or waterproofing installation has been inspected.
B. Verify structural ability of unsupported walls to support loads imposed by fill.
C. Verify survey bench mark and intended elevations for the Work are as indicated on Drawings.

3.2 PREPARATION

A. Identify required lines, levels, contours, and datum.
B. Compact subgrade to density requirements for subsequent backfill materials.
C. Cut out soft areas of subgrade not capable of compaction in place. Backfill with structural fill and compact to density equal to or greater than requirements for subsequent fill material.
D. Scarify subgrade surface to depth of 6 inch.

3.3 FILLING

A. Fill areas to subgrade contours and elevations with unfrozen materials per the following schedule:

<table>
<thead>
<tr>
<th>Location</th>
<th>Required Material</th>
<th>Maximum Compacted Lift Thickness</th>
<th>Minimum Proctor Compaction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Areas Beneath Footings or Structures</td>
<td>Coarse Aggregate (A3)</td>
<td>10”</td>
<td>95% Modified</td>
</tr>
<tr>
<td>Footing, Foundation and Structure Backfill</td>
<td>Structural Fill (S2)</td>
<td>10”</td>
<td>95% Modified</td>
</tr>
<tr>
<td>Areas Beneath Asphalt or Concrete Pavements</td>
<td>Granular Fill (S1)</td>
<td>10”</td>
<td>95% Modified</td>
</tr>
<tr>
<td>Grass Areas and Non-Structural Slope Fill</td>
<td>Earth Fill (S3)</td>
<td>10”</td>
<td>85 % Modified</td>
</tr>
</tbody>
</table>

B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
C. Place material in continuous layers and compact in accordance with the schedule at the end of this section.
D. Employ placement method that does not disturb or damage other work.
E. Maintain optimum moisture content of backfill materials to attain required compaction density.
F. Backfill against supported foundation walls. Do not backfill against unsupported foundation walls.
G. Backfill simultaneously on each side of unsupported foundation walls until supports are in place.
H. Slope grade away from building minimum 2 percent slope for minimum distance of 10 ft, unless noted otherwise.
I. Make gradual grade changes. Blend slope into level areas.
J. Remove surplus backfill materials from site.
K. Leave fill material stockpile areas free of excess fill materials.

3.4 TOLERANCES
A. Top Surface of Backfilling Within Building Areas: Plus or minus 1/2 inch from required elevations.
B. Top Surface of Backfilling Under Paved Areas: Plus or minus 1 inch from required elevations.
C. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.5 FIELD QUALITY CONTROL
A. Perform Proof-Roll (roll-test) of finished filled traffic areas in accordance with Section 31 2216.15.

3.6 PROTECTION OF FINISHED WORK
A. Reshape and re-compact fills subjected to vehicular traffic.

END OF SECTION 31 2323
SECTION 32 1123 – AGGREGATE BASE COURSES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aggregate base course.

B. Related Sections:
   1. Section 31 0516 – Aggregates for Earthwork
   2. Section 31 2216.15 – Roadway Subgrade Preparation
   3. Section 31 2316.13 – Trenching
   4. Section 31 2323 – Fill
   5. Section 32 1216 – Asphalt Paving
   6. Section 32 1313 – Concrete Paving

1.2 REFERENCES

A. American Association of State Highway and Transportation Officials:

1.3 SUBMITTALS

A. Materials Source: Submit name and location of imported materials suppliers.

B. Test Reports: Submit test reports for each imported aggregate material.

1.4 QUALITY ASSURANCE

A. Furnish each aggregate material from single source throughout the Work.

B. Perform Work in accordance with State of Wisconsin Department of Transportation standards.

PART 2 – PRODUCTS

2.1 AGGREGATE MATERIALS

A. Aggregate material shall consist of virgin material or recycled asphalt or concrete pavement. All materials to come from a location within a 500 mile radius of the project location.

B. Coarse Aggregate: Type A1, A2, A3, and A6: as specified in Section 31 0516.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify substrate has been inspected, gradients and elevations are correct, and is dry.
3.2 PREPARATION
A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
B. Do not place fill on soft, muddy, or frozen surfaces.
C. Subgrade Approval and Proof-Roll: Prior to placing aggregate base course perform proof-roll as described in Section 31 2216.15.

3.3 AGGREGATE PLACEMENT
A. Place aggregate in maximum 6 inch layers to total compacted thickness as indicated on the drawings.
B. Roller compact aggregate to 95 percent maximum dry density or other as indicated on Drawings.
C. Level and contour surfaces to elevations and gradients indicated.
D. Add small quantities of fine aggregate to coarse aggregate as appropriate to assist compaction.
E. Maintain optimum moisture content of fill materials to attain required compaction density.
F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES
A. Maximum Variation From Flat Surface: 1/4 inch measured with 10 foot straight edge.
B. Maximum Variation From Thickness: 1/4 inch.
C. Maximum Variation From Elevation: 1/4 inch.

END OF SECTION 32 1123
SECTION 32 1216 – ASPHALT PAVING

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Asphalt materials.
   2. Asphalt paving base course, binder course, and wearing course.
   3. Pavement Markings

B. Related Sections:
   1. Section 31 2216.15 – Roadway Subgrade Preparation
   2. Section 31 2323 – Fill
   3. Section 32 1123 – Aggregate Base Courses

1.2 REFERENCES


1.3 SUBMITTALS

A. Materials Source: Submit name and location of asphalt materials supplier.

B. Mix Design: Submit warm mix asphalt mix design.
   1. Mix design to include a pre-approved warm mix asphalt additive as listed in this specification.
   2. Submit unmodified asphalt binder certification including performance grade (PG) designation, recommended mixing temperature and recommended compaction temperatures.
   3. Warm mix asphalt mixture design to have a minimum of 20 degree F temperature reduction from the mixing temperature of the unmodified binder.

C. Quality Control Plan: Submit Quality Control Plan including the following:
   1. Documentation of Lab Qualification under Wisconsin DOT Lab Qualification Program.
   2. Certification of Lab Technicians to a minimum level of HMA Tech I under the State Highway Technician Certification Program.

1.4 QUALITY ASSURANCE

A. Obtain materials from same source throughout.

B. Perform testing in accordance with State of Wisconsin Department of Transportation standards.

C. Contractor Testing: As a condition of acceptance, arrange, conduct, and pay for tests necessary to demonstrate satisfactory compliance with Contract Documents. Make any adjustments at the plant necessary to meet the requirements of the Specifications.

1.5 LAB TESTING

A. The Contractor shall test material from the plant at least once a day.

1.6 DENSITY TESTING

A. The Contractor shall take a minimum of one test per location and one test per 250 ton.
   1. Test will be taken by the nuclear method.
   2. Operator will use the Maximum Specific Gravity running average of four from specified mix design.
3. Targets will be according to the latest edition of the WisDOT Supplemental Specifications section 460.3.3.

B. Locations will be at the Engineer’s discretion.

1.7 RESULTS AND REPORTS

A. The Contractor shall make field adjustments to keep material within the specified tolerances. If test results fall out of tolerance, the Contractor shall increase testing frequency until material is back within specification.

B. The Contractor shall submit test reports to the Engineer at the end of the project or upon the Engineer’s request.

1.8 QUALIFICATIONS

A. Contractors shall be Wisconsin DOT approved producers and pavers.

1.9 WARRANTY

A. Special Warranty: Provide a 1 year warranty on the materials and workmanship for all items under this section from the date of substantial completion.

PART 2 – PRODUCTS

2.1 ASPHALT MATERIALS

A. All asphalt pavement materials shall conform with the State of Wisconsin Standard Specifications for Highway and Structure Construction, Current Edition, Section 460.2.

2.2 HOT MIX ASPHALT (HMA) PAVEMENT

A. Provide HMA pavement conforming to the requirements of WisDOT SSHSC Section 450 and Section 460. Conform all materials provided under this section to the requirements of WisDOT SSHSC, Section 455 and as revised in any current Supplemental Specifications.

B. Provide HMA mix types and layer thicknesses as shown on the Drawings.

2.3 PAVEMENT MARKINGS

A. Pavement Markings materials shall be approved for use by WisDOT and in accordance with Section 646 of the State of Wisconsin Standard Specifications for Highway and Structure Construction, Current Edition

1. Type: See Drawings

2. Color: See Drawings

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify utilities indicated under paving are installed with excavations and trenches properly backfilled and compacted.

B. Verify compacted aggregate base is dry and ready to support paving and imposed loads.

C. Verify gradients and elevations of aggregate base are correct to match the flow pattern identified in the plans.
D. Verify gutter drainage grilles and frames manhole frames and are installed in correct position and elevation.

3.2 EXISTING WORK
A. Saw cut and notch existing paving as indicted on Drawings.
B. Clean existing paving to remove foreign material, excess joint sealant and crack filler from paving surface.
C. Repair surface defects in existing paving to provide uniform surface to receive new paving.

3.3 CONSTRUCTION
A. All construction shall conform with Sections 450 and 460.3 of the State of Wisconsin Standard Specifications for Highway and Structure Construction, Current Edition.
B. Apply tack coat between all lifts in accordance with Section 450.3.2.7
C. Maintain surface tolerances in accordance with Section 450.3.2.9

3.4 PAVEMENT MARKINGS
A. Install pavement markings at the locations shown on the drawings.
B. Prepare surfaces to receive markings and install markings in accordance with Section 646 of with the State of Wisconsin Standard Specifications for Highway and Structure Construction, Current Edition
C. Apply multiple coats of marking material such that no substrate is visible through the installed marking.
D. Parking stall markings and symbols to be 4-inch wide (minimum).
E. ADA symbols and travel lane directional symbols shall conform to WisDOT standard templates.

END OF SECTION 32 1216
SECTION 32 1313 – CONCRETE PAVING

PART 1 – GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Concrete Sidewalk
   2. Valley Gutter
   3. Exterior Concrete Pads

B. Related Sections:
   1. Section 32 1123 – Aggregate Base Courses

1.2 REFERENCES
A. American Concrete Institute:
   1. ACI 301 - Specifications for Structural Concrete.
   2. ACI 304 - Guide for Measuring, Mixing, Transporting, and Placing Concrete.

1.3 SUBMITTALS
A. Concrete Mix Design: Submit proposed mix designs for each class of concrete a minimum of 7 days prior to
   the start of work in this section.
B. Product Data: Submit data on joint filler, concrete admixtures and curing compounds.
C. Delivery Tickets: Submit delivery tickets from each load of concrete delivered.
D. Test Results: Submit test results for required testing.

1.4 DELIVERY, STORAGE, AND HANDLING
A. The Contractor shall not have concrete delivered until forms, reinforcement, and embedded items are in
   place and ready for concrete placement. The Contractor shall coordinate with the Owner and building
   addition General Contractor for job site storage of materials.
B. The Contractor shall store reinforcements of different sizes and shapes in separate piles or racks. The piles
   or racks shall be raised above the ground to avoid excessive rusting. The Contractor shall protect materials
   from contaminants, such as grease, oil, and dirt.
C. The Contractor shall ensure that materials can be accurately identified after bundles are broken and tags
   removed.

1.5 TESTING
A. An independent testing firm, hired by the Contractor, shall perform all concrete tests in accordance with ACI
   301, except that the sampling shall be done from the truck.
B. Perform one set of tests for each 30 CY of concrete placed. Testing to include:
   1. Slump
   2. Air entrainment
   3. Cylinders for compression testing. Cast a minimum of 6 cylinders for each test. Perform two
      breaks at 7 days, 28 days and other if results are required prior to 28 days.
C. Tests may be required of in-place concrete by the testing laboratory if concrete is suspected of being unacceptable. Test may be core cylinders complying with ASTM C42. Such testing will be at the Contractor's expense and any other additional testing when the concrete is unacceptable.

D. Unacceptable concrete work shall be corrected at the Contractor's expense and without a time extension for removing and replacing the defective work.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with ACI 301.

B. Obtain cementitious materials from same source throughout.

C. Follow recommendations of ACI 305R when concreting during hot weather.

D. Follow recommendations of ACI 306R when concreting during cold weather.

E. Visual Standard: All flatwork will be reviewed by the Architect for quality control. Concrete finish and joint control will be held to a high standard and all decisions by Architect will be binding. Discoloration, motting, poor jointing will not be acceptable. All work rejected by the Architect for failure to meet the "visual standard" shall be promptly removed and re-installed at a quality acceptable to the Owner and Architect.

PART 2 – PRODUCTS

2.1 FORM MATERIALS

A. Form Materials: Conform to ACI 301.

B. Joint Filler: ASTM D1751 type; 1/2 inch thick.

C. Joint Sealants: Cold applied; ASTM C920 for grade, class and uses indicated.

2.2 REINFORCING STEEL

A. Reinforcing Steel: ASTM A615, 60 ksi yield grade billet steel deformed bars; uncoated finish.

2.3 CONCRETE MATERIALS

A. Cement ASTM C150, normal - Type I/II, Portland, gray color.

B. Fine and Coarse Aggregates: ASTM C33, Coarse aggregate size as shown in mix class. Gradation to comply with ASTM C-33, Table II, within the following limits:

C. Use 3/4" to No. 4 aggregate for footings, slabs, plain concrete, walls and pavement.

D. Fine aggregate to be natural sand. Aggregates to be free of iron oxide and not more than 2.5% soft particles.

2.4 ADMIXTURES

A. Air Entrainment Admixture: ASTM C260

B. Chemical Admixtures for Concrete: ASTM C494.
2.5 CURING MATERIALS

A. Water: Shall be potable and free from injurious amounts of oil, alkalis or organic matter.

B. Membrane Curing Compound: ASTM C309, Type 1.

2.6 CONCRETE MIX

A. Mix Concrete in accordance with ASTM C94.

B. All Concrete:
   1. Minimum compressive strength (28 days): 4000 psi., as tested by ASTM C39, and proportioned by ACI 318.
   2. Note: Some jurisdictions may require special inspections above 2500psi.
   3. Slump: 4 inch maximum - 1 inch minimum.
   4. Water Cement Ratio: 0.45

C. Concrete exposed to the weather including foundations and exterior slabs shall be air-entrained conforming to ASTM C 260 at the rate of 5% to 7% for 3/4" aggregate concrete. Air content to be determined by "Pressure Method" ASTM C-231 or "Volumetric Method" ASTM C-173.

PART 3 – EXECUTION

3.1 FORMWORK ERECTION

A. Verify lines, levels, and measurements before proceeding with formwork.

B. Hand trim sides and bottom of earth forms; remove loose dirt.

C. Coordinate work of other Sections in forming and setting openings, slots, recesses, chases, sleeves, bolts, anchors, embedded plates and angles, and other inserts.

D. Formwork shall comply with all pertinent provisions of ACI 347.

E. Forms shall remain in place for a minimum of 24 hours after concrete placement and finishing.

F. The Contractor shall construct formwork for exposed concrete surfaces with smooth faced, undamaged plywood or other panel type materials acceptable to Owner in order to provide continuous straight, smooth as-cast surfaces. The Contractor shall furnish in largest, practicable sizes in order to minimize the joints.

G. The Contractor shall provide form material with sufficient thickness to withstand the pressure of the newly placed concrete without exceptional bow or deflection.

H. Side forms for footings may be omitted and concrete poured directly against excavation only when requested by the Contractor and accepted by Owner. When omission of forms is accepted, the Contractor shall provide additional concrete (1") on each side of the minimum design profile of sides and dimensions shown.

I. Cleaning and Tightening:
   1. The Contractor shall thoroughly clean forms and adjacent surfaces that are to receive concrete.
   2. The Contractor shall remove chips, wood, sawdust, dirt, and other debris just before concrete is placed.
   3. The Contractor shall retighten forms immediately after concrete placement, as required, to eliminate mortar leaks.
3.2 REINFORCEMENT PLACEMENT

A. Supports for Reinforcement: For slabs on grade, the Contractor shall use supports with sand plates or horizontal runners where base material will not support chair legs. Pieces of concrete block or bricks will not be permitted.

B. Steel supports shall comply with CRSI recommendations.

C. The Contractor shall position, support, and secure reinforcement against displacement by formwork, construction, or concrete placement operations. The Contractor shall locate and support reinforcing by ties, spacers, chairs or hangers, as required.

D. The Contractor shall clean reinforcement to remove loose rust and mill scale, earth, and other materials.

3.3 CONCRETE PLACEMENT

A. Place concrete in accordance with the most stringent of either ACI 304 or this section.

B. Before placing concrete, remove debris, ice, snow, and other foreign materials from the subgrade or formwork.

C. Remove standing water from subgrade. Dry and compact subgrade in accordance with the requirements of Division 31. Do not place concrete on soft or frozen subgrade.

D. Place and secure steel reinforcement prior to placing concrete.

E. Position and secure expansion joint material, sleeves, waterstops and other imbedded items prior to placing concrete. Place imbedded items in accordance with the most stringent of either drawings or manufacturer recommendations.

F. Apply bonding agent to existing concrete surfaces requiring a bond with new concrete.

G. Convey concrete from truck to final position by method that will prevent separation.

H. Unless otherwise approved, limit free fall of concrete to 4’ maximum height to avoid separation.

I. Place concrete continuously so that concrete is deposited on or adjacent to concrete that is still plastic. When placing of concrete is temporarily halted or delayed, provide construction joints.

J. Place concrete in lifts not exceeding 18”.

K. Consolidate concrete by mechanical vibration. Allow vibrator to penetrate the full depth of the slab or lift. Overlap previously vibrated areas by 25%.

3.4 CONCRETE FINISH

A. Screed or strike off the surface of the slab using straightedge or vibratory screed.

B. After screeding, bullfloat or darby the concrete surface to provide uniform surface, free of ridges or voids. Complete prior to bleed water collection.

C. Once bleed water has evaporated and the concrete can sustain foot pressure, complete edging/jointing and floating.
D. Complete initial edging and hand tool jointing prior to floating. Re-edge or re-tool joints as necessary to receive uniform finish and specified Architectural features as finishing progresses.

E. Float surface with hand or power floats. Do not add water or dry cement on surface to modify conditions.

F. Surface tolerance shall be 1/8” measured from a 10-foot straightedge resting at any two points on the slab down to the concrete surface. Areas out of tolerance shall be removed and replaced unless a repair method is presented by the Contractor and approved by Architect/Engineer and Owner.

G. Unless otherwise indicated, flatwork/slabs for exterior sitework shall be provided with a broomed finish. Broom slabs transverse to the main direction of traffic unless noted otherwise on Drawings. Use approved broom finish texture and scoring patterns as shown on the Drawings.

H. Joint Sealants: Examine, clean, prime and install per written Manufacturer’s instructions.

END OF SECTION 32 1313
SECTION 32 3119 – SLIDING METAL GATES

PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Sliding steel gates.

B. Related Sections:
   1. Division 03 Section “Cast-in-Place Concrete” for concrete.
   2. Division 26 Sections for electrical service and connections for motor operators and controls.
   3. Division 31 Section “Earth Moving.”

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For gates. Include plans, elevations, sections, details, and attachments.

C. Welding certificates.

1.3 QUALITY ASSURANCE

A. Preinstallation Conference: Conduct conference at Project site.

PART 2 - PRODUCTS

2.1 STEEL

A. Plates, Shapes, and Bars: ASTM A 36/36 M.

B. Tubing: ASTM A500, cold-formed steel tubing.

C. Uncoated Steel Sheet: Hot-rolled steel sheet, ASTM A 1011/A 1011M, Structural Steel, Grade 45 or cold-rolled steel sheet, ASTM A 1008/A 1008 M, Structural Steel, grade 50.

D. Galvanized-Steel Sheet: ASTM A 653/A 653 M, structural quality, Grade 50, with G90 coating.

2.2 COATING MATERIALS

A. Epoxy Zinc-Rich Primer for Steel: Complying with MPI #20 and compatible with coating specified to be applied over it.
   1. Use primer with a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
B. Epoxy Primer for Galvanized Steel: Complying with MPI #101 and compatible with coating specified to be applied over it.

1. Use primer with a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

C. Epoxy Primer Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.

1. Use primer with a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

D. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.

2.3 MISCELLANEOUS MATERIALS

A. Concrete: Normal-weight, air-entrained, ready-mix concrete complying with requirements in Division 03 Section “Cast-in-Place Concrete” with a minimum 28-day compressive strength of 3000 psi, 3-inch slump, and 1-inch maximum aggregate size or dry, packaged, normal-weight concrete mix complying with ASTM C 387 mixed with potable water according to manufacturer’s written instructions.

B. Nonshrink Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107, and specifically recommended by manufacturer for exterior applications.

2.4 STEEL GATES

A. Steel Gates: Bi-parting gates made from 16 gauge steel; hot-dip galvanized; see Drawings for dimensions. Provide complete system and hardware package including, but not limited to, guide posts, roller, guide rail, frame extension, v-track, chain attach brackets, chain, gate opener platform.

1. Manufacturers:
   a. Amazing Gates.
   b. Approved equal.

B. Finish for Steel Items: Powder coating.

2.5 STEEL FINISHES

A. Surface Preparation: Clean surfaces according to SSPC-SP 5/NACE No. 1, “White Metal Blast Cleaning.”

1. After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

B. Powder Coating: Immediately after cleaning, apply 2-coat finish consisting of epoxy primer and TGIC polyester topcoat, with a minimum total dry film thickness of not less than 8 mils. Comply with coating manufacturer’s written instructions.

1. Color and Gloss: As selected by Architect from manufacturer’s full range.

C. Primer Application: Apply zinc-rich epoxy primer immediately after cleaning to provide a minimum dry film thickness of 2 mils per applied coat, to surfaces that will be exposed after assembly and installation, and to concealed surfaces.
2.6 GATE OPERATORS

A. General: Provide factory-assembled automatic operating system designed for gate size, type, weight, and operation frequency.

B. Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type and efficiency requirements for motors.

C. Gate Operators: Gate mounted.

D. Remote Controls: Electric controls separated from gate and motor and drive mechanism.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for site clearing, earthwork, pavement work, construction layout, and other conditions affecting performance of the Work.

B. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of gates and posts. Indicate locations of utilities, lawn sprinkler system, underground structures, and benchmarks.

3.3 GATE INSTALLATION

A. Install gates according to manufacturer’s written instructions, level, plumb, and secure for full opening without interference. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation and lubricate where necessary.

3.4 ADJUSTING

A. Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches engage accurately and securely without forcing or binding.

B. Automatic Gate Operators: Energize circuits to electrical equipment and devices. Adjust operators, controls, safety devices, and limit switches.

C. Lubricate hardware, gate operators, and other moving parts.

END OF SECTION 32 3119
PART 1 GENERAL

1.1 SUMMARY

A. The work under this section shall consist of providing all work, materials, labor, equipment and supervision necessary to construct the stormwater bioretention area.

B. Related Sections:
   1. Section 31 2316 – Excavation
   2. Section 31 9113 – Soil Preparation
   3. Section 33 4000 – Storm Drainage Utilities

1.2 STANDARDS REFERENCED

A. Wisconsin DNR Technical Standard 1004 – Bioretention For Infiltration

B. Wisconsin DNR Specification S100 – Compost

1.3 SUBMITTALS

A. Submit a list of all plant and soil materials to be used.

B. Submit planting plan.

C. Submit manufacturers cut sheet for geotextile drainage fabric.

1.4 QUALITY ASSURANCE

A. Work to be done by landscape contractor regularly engaged in the construction of bio-retention systems, native seeding and planting work.

PART 2 PRODUCTS

2.1 GENERAL

A. All products shall meet the requirements of Wisconsin DNR Technical Standard 1004 – Bioretention For Infiltration

2.2 ENGINEERED SOIL MIX

A. Compost shall meet the requirements of Wisconsin DNR Specification S100 – Compost.

B. Sand shall be USDA poorly graded course sand (0.02 – 0.04 inches).

C. Sand and compost mix shall be combined to the proportions noted in the drawings.

2.3 PLANTS

A. All plants, unless otherwise specifically permitted, shall conform to the standards of the current edition of American Standard for Nursery Stock as approved by the American Standards Institute, Inc.
B. Plants shall be able to tolerate saturated soil conditions for the length of time anticipated in the design storm event, as well as snow melt chemicals and other anticipated runoff constituents.

C. Plants chosen shall be from the list noted in the drawings, or other which meet the design intent.

2.4 SEED

A. Seed shall be wet detention type mix suitable for saturated soil conditions.

2.5 GEOTEXTILE FABRIC

A. The filter fabric shall meet the requirements of the WisDOT SSSH C Section 645.2.4, Geotextile Fabric Type DF, Schedule B.

2.6 PIPE

A. Cleanout Pipe
1. The cleanout pipe shall be rigid, non-perforated PVC covered with a watertight cap.

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Construct bioretention areas in accordance with the drawings.

B. Bioretention materials shall not be placed until all contributing drainage areas are stabilized. Below grade construction may occur, at Contractors option, provided the system is protected with silt fence until site work substantial completion and vegetation establishment. The Contractor is responsible for protection of systems during construction and shall replace any work that has become plugged as a result of siltation from construction activities.

C. The bioretention facility shall be excavated to the dimensions, side slopes, and elevations shown on the drawings. The method of excavation shall minimize the compaction of the bottom of the bioretention facility. Excavators and backhoes, operating on the ground adjacent to the bioretention facility, shall be used to excavate the facility if possible. No heavy equipment shall be allowed on the bottom of the bioretention area.

D. Trees, shrubs, and other plant materials specified for bioretention facilities shall be planted as specified in the Contract Plans and applicable landscaping standards with the exception that pesticides, herbicides, and fertilizer shall not be applied during planting under any circumstances. Furthermore, pesticides, fertilizer, and any other soil amendments shall not be applied to the bioretention facility during landscape construction, plant establishment, or maintenance.

END OF SECTION 32 9300
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Seeding.

B. Basic Requirements:

1. Any turf must be drought-tolerant.
2. Add soil amendments as appropriate.
3. All compacted soil (e.g. from construction vehicles) must be tilled to at least six (6) inches.

1.2 DEFINITIONS

A. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

B. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Schedule: Indicating anticipated dates for seeding.

C. Maintenance Instructions: Printed instructions for recommended procedures to be established by Owner for maintenance of seeded areas during a calendar year.

D. Product certificates.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf establishment.

1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress
2. Pesticide Applicator: State licensed, commercial.
1.6  DELIVERY, STORAGE, AND HANDLING

A.  Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

1.7  MAINTENANCE SERVICE

A.  Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following periods:

1.  Seeded Turf: Maintain seeded areas by watering, fertilizing, weeding, mowing, trimming, and other operations such as rolling, regrading, and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.
   a.  Maintenance Period for all Seeded Areas: 60 days from date of Substantial Completion. When initial maintenance period has not elapsed before end of planting season, or if turf is not fully established, continue maintenance during next planting season until acceptable stand of seeded area is established.

PART 2 - PRODUCTS

2.1  SEED

A.  Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA’s “Journal of Seed Technology; Rules for Testing Seeds” for purity and germination tolerances.

B.  Seed Species: Use state-certified seed of grass species appropriate for planting area, i.e. full sun, sun and partial shade, shade.

C.  Refer to Civil-Site Plans.

2.2  TOPSOIL

A.  Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 2 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth.

   1.  Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient.

   2.  Any extra topsoil to be removed from the site by the Contractor.

2.3  ORGANIC SOIL AMENDMENTS

A.  Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.
B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

B. Seeded Area Fertilizer: Phosphorus free granular or pelleted fertilizer to provide not less than 1 lb. of actual nitrogen per 1,000 square feet of seeded area. Provide nitrogen in a form that will be available to lawn during initial growth period.

2.5 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

B. Sphagnum Peat Mulch: Partially decomposed sphagnum peat moss, finely divided or of granular texture, and with a pH range of 3.4 to 4.8.

C. Muck Peat Mulch: Partially decomposed moss peat, native peat, or reed-sedge peat, finely divided or of granular texture, with a pH range of 6 to 7.5, and having a water-absorbing capacity of 1100 to 2000 percent, and containing no sand.

D. Compost Mulch: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 1-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

2.6 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 TURF AREA PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing exterior plants from damage caused by seeding operations.

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

C. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.
D. Before planting, obtain Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.2 SEEDING

A. Do not use wet seed or seed which is moldy or otherwise damaged in transit or storage.

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

C. Apply topsoil to provide 4 inches compacted depth. Grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll and rake and remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.

D. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before plantings lawns. Do not create a muddy soil condition. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

E. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph.

   1. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.
   2. Do not use wet seed or seed that is moldy or otherwise damaged.
   3. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

F. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

G. Protect seeded slopes with erosion control netting or other methods acceptable to the Architect.

H. Protect seeded areas from hot, dry weather or drying winds within 24 hours after completing seeding operations. Soak areas, and roll surface smooth.

3.3 EROSION CONTROL

A. Provide erosion control fence checking in ditches or problem swales at intervals required to adequately slow water velocity and impede soil loss. Provide erosion control for seeded areas on slopes that exceed 4:1, in swales and adjacent to parking lot pavement.

B. Roll mat strips out in the direction of water flow, without stretching and with all parts bearing on the soil; netting side on top. Overlap adjacent strips at least 4 inches. Overlap strip ends at least 10 inches. All overlaps shall be made with the upgrade section on top. Bury upgrade end of mat strips at least 6 inches in the soil.

C. Secure mat in place with staples at 3 ft. on center maximum spacing.

D. See also Civil-Site Plans.

3.4 TURF MAINTENANCE

A. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
B. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings.

3.5 Satisfactory Turf

A. Turf installations shall meet the following criteria as determined by Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 5 by 5 inches.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

3.6 Cleanup and Protection

A. During seeding operations keep adjacent pavings and construction clean and work area in an orderly condition.

B. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

3.7 Inspection and Acceptance

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

B. Where inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until reinspected by Architect and found to be acceptable.

END OF SECTION 32 9200
SECTION 32 9300 – PLANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Trees.
   2. Groundcover and Perennials.
   3. Topsoil and soil amendments.
   4. Fertilizers and mulches.
   5. Stakes and guys.
   6. Landscape edging.

B. Basic Requirements:
   1. Introduce no invasive plant species into the landscape. Invasive plant species vary by region. Consult the local Cooperative Extension Service or state agencies. A list of regional resources is available from the U.S. Department of Agriculture, at www.invasivespeciesinfo.gov/unitedstates/state.shtml Not all nonnative species are considered invasive.
   2. Add mulch or soil amendments as appropriate. (Mulch is defined as a covering placed around plants to reduce erosion and water loss and to help regulate soil temperature. In addition, upon decomposition, organic mulches serve as soil amendments. The type of mulch selected can affect soil pH.
   3. All compacted soil (e.g. from construction vehicles) must be tilled to at least 6 inches.
   4. Install landscaping such that all parts of mature plants will be at least 24 inches from the buildings.

C. See Civil-Site Drawings for Plantings and Planting Plan.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated, including soils.

B. Nursery stock. Indicate species, quantity and nursery supplying material for all plants.

C. Planting Schedule: Indicating anticipated planting dates for plants.

D. Maintenance Instructions: Typewritten instructions for recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

E. Detailed Planting Plan.

1.3 QUALITY ASSURANCE

A. Installer’s Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

   1. Installer’s Field Supervision: Require installer to maintain an experienced full-time supervisor on Project site when planting is in progress.
B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1, "American Standard for Nursery Stock."
   1. If specified landscape material is not obtainable, consult with Architect to determine appropriate substitution. When authorized, adjustment of contract amount will be made.

C. Tree Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take caliper measurements 6 inches above ground for trees. Measure main body of tree for height and spread; do not measure branches or roots tip-to-tip.

D. Observation: Architect may observe trees either at place of growth or at site before planting for compliance with requirements for genus, species, variety, size, and quality. Architect retains right to observe trees further for size and condition of balls and root systems, insets, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees immediately from Project Site.
   1. Notify Architect of sources of planting materials 30 days in advance of delivery to site.

1.4 DELIVERY, STORAGE, AND HANDLING
   A. Do not prune trees before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.
   B. Handle planting stock by root ball.
   C. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in shade, protect from weather and mechanical damage, and keep roots moist.
   D. Maintain at least one tree label tag per area or grouping to remain to confirm plant botanical and common names.
   E. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

1.5 COORDINATION
   A. Planting Restrictions: Proceed with and complete landscape work as rapidly as portions of the site become available, working within seasonal limitations for each kind of landscape work required.
      1. Utilities: Determine the location of underground utilities and perform work in a manner which will avoid possible damage. Hand excavate, as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
      2. Excavation: When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify the Architect before planting.
   B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit.
   C. Coordination with Lawns: Plant trees after finish grades are established and before planting lawns, unless otherwise acceptable to Architect.
      1. When planting trees after lawns, protect lawn areas and promptly repair damage caused by planting operations.
D. Planting Plans:

1. A complete list of plants, including a schedule of sizes, quantities and other requirements are on the Civil-Site Plans.

1.6 WARRANTY

A. Special Warranty: Warrant the following plants, for the warranty period indicated, against defects including death and unsatisfactory growth, except for defects resulting from lack of adequate maintenance, neglect, or abuse by Owner, or incidents that are beyond Contractor's control.

1. Warranty Period for Plants – trees and all groundcovers/perennials: One year from date of Substantial Completion.

   a. Remove dead plants immediately. Replace immediately unless required to plant in the succeeding planting season. Only one replacement will be required at the end of the warranty period, except for losses or replacements due to failure to comply with specified requirements.

   b. Replace plants that are more than 25 percent dead or in an unhealthy condition at the end of the warranty period.

1.7 MAINTENANCE SERVICE

A. Maintain trees and other plants for the following maintenance period by pruning, cultivating, watering, weeding, fertilizing, trimming, restoring planting saucers, tightening and repairing stakes and guy supports, and resetting to proper grades or vertical position, as required to establish healthy, viable plantings. Spray as required to keep trees free of insects and disease. Restore or replace damaged tree wrappings.

1. Maintenance Period for all Plants: 60 days from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Civil-Site Drawings and complying with ANSI Z60.1, with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, free of disease, insects, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

B. Grade: Provide trees of sizes and grades complying with ANSI Z60.1 for type of trees required. Trees of a larger size may be used if acceptable to Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Label each tree with securely attached, waterproof tag bearing legible designation of botanical and common names.

E. If formal arrangements or consecutive order of trees is shown, select stock for uniform height and spread, and number label to assure symmetry in planting.
F. Groundcovers and Perennials: Provide healthy, field-grown plants from a commercial nursery, of species and variety shown or listed, established and well rooted in removable containers and complying with ANSI Z60.1 for the pot size shown or listed.

2.2 TOPSOIL

A. Topsoil: ASTM D 5268, pH range of 5.5 to 7, a minimum of 2 percent organic material content; free of stones 1 inch or larger in any dimension and other extraneous materials harmful to plant growth.

1. Topsoil Source: Reuse surface soil stockpiled on-site. Verify suitability of stockpiled surface soil to produce topsoil. Clean surface soil of roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth. Supplement with imported or manufactured topsoil from off-site sources when quantities are insufficient.

2. Any extra topsoil to be removed from the site by the Contractor.

2.3 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings.

B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.4 FERTILIZERS

A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen and potassium in the following composition:

1. Composition: 20 percent nitrogen and 10 percent potassium, by weight.

2.5 MULCHES

A. Organic Mulch: Shredded hardwood, ground or shredded bark, threshed straw. Refer to Civil-Site Plans.

B. Shredded Cedar Bark Mulch: Free from deleterious materials and suitable as a top dressing. Twice Shredded Cedar Bark Mulch for perennial beds. Refer to Civil-Site Plans.

C. Locally Sourced Glacial Washed Stone. #2 locally sourced glacial washed stone, washed free of loam, sand, clay, and other foreign substances. Refer to Civil-Site Plans.

D. Antierosion Mulch: Clean, seed free salt hay or threshed straw of wheat, rye, oats or barley. Refer to Civil-Site Plans.

2.6 WEED-CONTROL BARRIERS

A. Nonwoven Fabric: Polypropylene or polyester fabric, 3 oz./sq. yd. minimum. For use under stone mulch only.
2.7 LANDSCAPE EDGINGS
   A. Standard Black Vinyl Rolled Top Edging: Extruded in standard lengths, with 9-inch plastic stakes.

2.8 MISCELLANEOUS PRODUCTS
   A. Antidesiccant: Water-insoluble emulsion, permeable moisture retardant, film forming, for trees. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer’s written instructions.
   B. Tackifier: Dry powder concentrate; Terra Tack AR or equal.
   C. Erosion Control Mat: Wood fiber blanket. Curlex erosion control blanket, as manufactured by American Excelsior Co., Arlington, Texas, or approved substitution with U-shaped steel wire staples, No. 11 gage, six inch length for firm soils, and 12 inches length for loose soils.
   D. Herbicides:
      1. Post-emergence vegetation control herbicide which, when applied to leaves and stems of vegetation, is absorbed and translocated to all parts of the plant including roots and underground stems and is capable of killing the entire plant. It shall be water-soluble and deactivate upon contact with soil, leaving no harmful residue.
      2. Selective Pre-emergence Herbicide that controls plants from emerging from seed, yet has no harmful effect on established plants when applied at recommended rates. The material shall resist leaching and remain effective throughout one growing season.
   E. Stakes and Guys: Provide stakes and deadmen of sound new hardwood, treated softwood or redwood, free of knot holes and other defects. Provide wire ties and guys of 2-strand, twisted, pliable galvanized iron wire not lighter than 12 ga. with zinc coated turnbuckles. Provide not less than ½ inch hose, cut to required lengths to protect tree trunks from damage by wires.

2.9 PLANTING SOIL MIX
   A. Planting Soil Mix: Mix topsoil with the following soil amendments in the following quantities:
      1. Ratio of Loose Compost (or Manure), Sand and Topsoil by Volume: 1:1:4 with Slow-Release Fertilizer at 1 lb/1000 SF.

PART 3 - EXECUTION

3.1 EXAMINATION
   A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
   A. Protect structures, utilities, sidewalks, pavements, and other facilities, and lawns and existing plants from damage caused by planting operations.
B. Provide erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Architect’s acceptance of layout before planting. Make minor adjustments as necessary.

D. Apply antidesiccant to trees using power spray to provide an adequate film over trunks, branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

   1. If deciduous trees are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after plantings.

3.3 PLANTING BED ESTABLISHMENT

   A. Loosen subgrade of planting beds to a minimum depth of 4 inches. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner’s property.

      1. Spread planting soil to a depth of 6 inches, but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

   B. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

   C. Restore planting beds if eroded or otherwise disturbed after finish grading and before planting.

   D. Refer to Civil-Site Plans.

3.4 TREE EXCAVATION

   A. Planting Pits and Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

      1. Excavate approximately three times as wide as ball diameter.
      2. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.

   B. Topsoil removed from excavations may be used as planting soil.

   C. Subsoil removed from excavations may be used as backfill.

   D. Obstructions: Notify Architect if unexpected rock or obstructions detrimental to trees are encountered in excavations.

   E. Drainage: Notify Architect if subsoil conditions evidence unexpected water seepage or retention in tree pits.

   F. Fill excavations with water and allow to percolate before positioning trees.

3.5 TREE PLANTING

   A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1.

   B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.
C. Set balled and burlapped stock plumb and in center of pit or trench with top of root flare 1 inch higher than adjacent finish grades.

1. Remove burlap and wire baskets from tops of root balls and partially from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.

2. Place planting soil mix around root ball in layers, tamping to settle mix and eliminate voids and air pockets. When pit is approximately one-half backfilled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing and tamping final layer of planting soil mix.

D. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE PRUNING

A. Prune, thin, and shape trees according to standard professional horticultural practices. Unless otherwise indicated by Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees; and prune to retain natural character.

3.7 GROUNDCOVER AND PERENNIAL PLANTING

A. Set out and space ground cover and plants as indicated.

B. Dig holes large enough to allow spreading of roots, and backfill with planting soil. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

C. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

D. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.8 PLANTING BED MULCHING

A. Install weed-control barriers in areas of stone mulch before mulching according to manufacturer’s written instructions. Completely cover area to be mulched, overlapping edges a minimum of 6 inches.

B. Mulch backfilled surfaces of planting areas and other areas indicated. Refer to Civil-Site Plans.

3.9 WEED BARRIER FABRIC INSTALLATION

A. Install weed barrier fabric in all stone mulched areas.

3.10 EROSION CONTROL

A. Provide erosion control fence checking in ditches or problem swales at intervals required to adequately slow water velocity and impede soil loss.
B. Roll mat strips out in the direction of water flow, without stretching and with all parts bearing on the soil; netting side on top. Overlap adjacent strips at least 4 inches. Overlap strip ends at least 10 inches. All overlaps shall be made with the upgrade section on top. Bury upgrade end of mat strips at least 6 inches in the soil.

C. Secure mat in place with staples at 3 ft. on center maximum spacing.

D. Refer to Civil-Site Plans.

3.11 EDGING INSTALLATION

A. Vinyl Edging: Install vinyl edging where indicated according to manufacturer's written instructions and Civil-Site Plan instructions. Anchor with plastic stakes spaced approximately 36 inches apart, drive below top elevation of edging.

3.12 CLEANUP AND PROTECTION

A. During planting, keep adjacent pavings and construction clean and work area in an orderly condition.

B. Protect plants from damage due to landscape operations, operations by other contractors and trades, and others. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged planting.

C. Disposal: Remove surplus soil and waste material, including excess subsoil, unsuitable soil, trash, and debris, and legally dispose of them off Owner's property.

3.13 INSPECTION AND ACCEPTANCE

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

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

3.14 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

D. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

END OF SECTION 32 9300